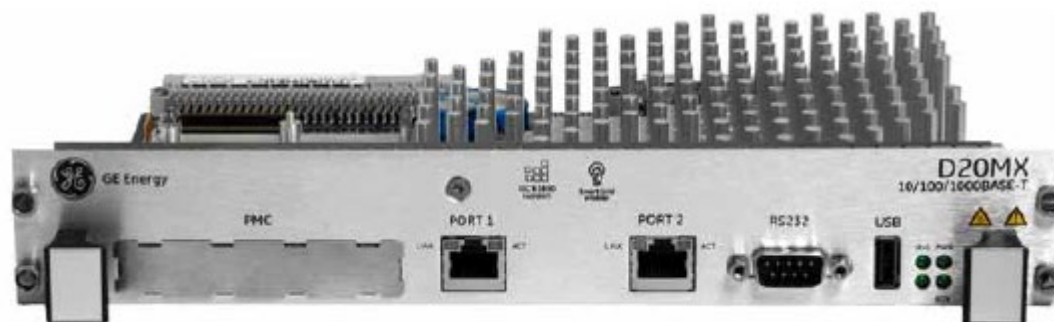


Multilin™ D20MX Guideform Specification

Product Bulletin

Date: October 3, 2017 **Classification:** GE Information

D20MX™ Substation Controller



The D20MX substation controller is a real-time device that executes mission-critical control applications for the reliable and safe operation of electrical substations. The D20MX represents the next innovation in GE's cyber secure RTU technology for NERC-CIP environments. It is built upon the field-proven Multilin D20 technologies and continues the tradition of reliable automation and control through high-quality and long-term product availability. The D20MX is backwards compatible with existing D20 installations. This document describes the minimum requirements for the D20MX substation controller.

This document provides the following information:

- [General Requirements](#) on page 2
- [Cyber Security](#) on page 2
- [Codes and Standards](#) on page 3
- [Internal Clock](#) on page 4
- [Power Supply](#) on page 4
- [Remote I/O modules](#) on page 4
- [SCADA Functions](#) on page 9
- [Communications](#) on page 11
- [D20MX Currently Supported Applications](#) on page 12
- [D20MX v1.7 \(currently in development\) Features](#) on page 16
- [Communication Protocols/Automation Applications](#) on page 16
- [Substation controller configuration tool](#) on page 17
- [Maintenance/Commissioning Facility](#) on page 17
- [Spare Parts](#) on page 18
- [Product Support](#) on page 18

General Requirements

Hardware Architecture

The substation controller (also referred to as “the controller” in this document) consists of a main processing unit with support for optional Input/Output (I/O) peripheral and communication modules to allow substation design scalability for small, medium or large substations as well as distributed or centralized I/O topologies. See the Point Counts section for details.

Database Storage

The database of the D20MX resides in the RAM. A Super capacitor allows the retention of the system clock time for 14-days. At power-up, the configuration resides in the RAM. At power-down, the configuration shall be transferred to the flash memory. This shall be made possible due to the seamless transaction between the RAM and flash. This arrangement shall protect the D20MX configuration from being lost, even after power-down for an indefinite period of time.

Form Factor

Substation controller main unit and peripheral modules shall be 19” rack mountable

Experience

Vendor shall demonstrate experience with supply, design, installation and commissioning of at least ten SCADA systems in Transmission and Distribution Substations consisting of at least fifty substations utilizing the same type of equipment offered in this proposal. These systems must be in successful operation for at least three years at the date of bid opening.

Reliability

Minimum design MTBF (Mean time Between Failures) for substation controller shall be a minimum of 10 years as per Military Handbook for "Reliability Prediction of Electronic Equipment". MIL-HDBK-217 @ 40°C ambient / 60°C inside the unit

Cyber Security

The Substation Controller shall provide the following security features:

- Centralized user authentication and authorization (RADIUS), including integration with Microsoft Servers using NPS and RSA Authentication Manager 8.1
- Role Based Access Control (RBAC) to keep operator and engineering activities separated, logged and simple
- IEEE 1686-2013 Password Complexity rules and one-way encryption
- Full auditing including Syslog integration to enterprise systems
- SFTP for secure network-based firmware upgrades and configuration file transfers
- SSH for secure network access to the maintenance facility
- SSH for secure programming and connection to the IEC 61131 programming facility

Cyber-Ark Plug-in support

In addition to the above, the substation controller shall support a plug-in available from Cyber Ark Software Ltd. This plug-in shall enable centralized user authentication and authorization with cyber-ark's Privileged Identity Management (PIM) Suite. This plug-in shall provide a one-time password model for the substation controller.

Codes and Standards

Substation controller equipment shall meet the following standards:

EMISSIONS			
EN55011 (CISPR 11)	ISM RF equipment - Electromagnetic disturbance characteristics	Radiated Emissions 30 MHz to 1 GHz	
		Conducted Emissions 150 kHz - 30 MHz	
IMMUNITY			
IEC 61000-4-2	Electrostatic discharge (ESD) immunity test		
IEC 61000-4-3	Radiated, radio-frequency electromagnetic field immunity test		
IEC 61000-4-4	Electrical fast transient/burst immunity test		
IEC 61000-4-5	Surge immunity test		
IEC 61000-4-6	Immunity to conducted disturbances, induced by radio- frequency fields		
IEC 60255-22-6			
IEC 60255-22-1	1 MHz burst immunity test		
IEC 61000-4-8	Power frequency magnetic field immunity test		
IEC 61000-4-9	Pulse magnetic field immunity test		
IEC 60255-22-1	Damped Oscillatory and Ring wave		
IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests		
IEC 61000-4-16	Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz		
IEC 61000-4-17	Ripple on DC input power port immunity test		
IEC 61000-4-29+	Voltage dips, short interruptions and voltage variations on DC input power port immunity test This standard only applies when using high voltage DC as the source (100 V DC to 300 V DC).		
SAFETY			
EC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - General requirements		
IEC 60255-5	Insulation coordination for measuring relays and protection equipment- Requirements and tests	Dielectric and Resistance measurements not applicable due to design (TVS in circuit)	
ENVIRONMENTAL			
IEC 60068-2-1	Cold	2 hours non powered, soak at - 40 °C, then warm to - 20 °C and leave powered for 16 hours	
IEC 60068-2-22	Dry Heat	16 hours powered at + 70 °C	
IEC 60068-2-6	Vibration (sinusoidal)	A logarithmic sweep from 10 Hz to 150 Hz to 10 Hz at 1 oct/min for 1 sweep cycle in the 3 orthogonal axes. Acceleration Pulse shape: Half sine Pulse duration: 11 mS	
IEC 60068-2-27	Shock - Operating Response Test Shock - Non-Operating With- stand Test	- Operating Response Test: Acceleration level: 5 g's - Non-Operating Withstand Test: Acceleration level: 15 g's 3 pulses per polarity per axis for a total of 18 pulses	
IEC 60068-2-29	Bump - Non operating test	Pulse shape: Half sine Pulse duration: 11 mS Acceleration level:	
IEC 60068-2-30	Damp heat, cyclic (12 h + 12 h cycle)		
IEC 60068-2-31	Drop and topple	Dropping on each face Dropping on each corner Toppling (or pushover) For a total of 12 drops	
IEC 60068-2-78	Humidity Testing	96 hours steady state humidity at 40 °C and 93% RH	

Internal Clock

The substation controller must use a Real-Time Clock (RTC) to time stamp all status changes to the nearest millisecond after the change has been detected by the logic (excluding any filter time imposed by the I/O interface circuits for contact de-bouncing).

The substation controller's software must use the RTC to maintain the time of day in order to time stamp and store the year, day, hour, minute, second, and millisecond for each alarm detected. Additionally, the substation controller shall request a time set by notifying the Master whenever a power failure occurs. The Master is capable of resetting the substation controllers time by issuing a time set command.

The substation controller shall provide an internal clock with not more than 0.1 second drift in 24 hours when not synchronized with an external source.

The substation controller shall be capable of supporting a SCADA master station protocol that contains time synchronization information to minimize one millisecond resolution deviation with respect to the Master computer real-time clock synchronization.

An IRIG-B interface must be available as an option.

Power Supply

The substation controller equipment shall be designed for continuous operation and shall support the following input voltages:

Nominal Input Voltage	Operation Range
24 VDC	20 to 60 VDC
48 VDC	20 to 60 VDC
120 VDC	100 to 300 VDC
120 VAC	85 to 264 VAC (50/60 Hz)

The Vendor shall guarantee satisfactory operation when the equipment is continuously energized at any voltage level from ± 10 per cent of nominal at the device rated operation temperatures.

The substation controller shall automatically recover from a power loss condition without affecting substation controller operation.

The substation controller power supply shall be protected from input power polarity reversal. DC input shall be fused and shall have diode protection against reverse DC polarity.

The power supply shall be provided with power on-off indicator and a power switch. Test points shall be accessible within the substation controller for all output voltages.

Each power supply shall be capable of providing an isolated 24 VDC or 48VDC wetting voltage output for external Digital Inputs. Wetting voltages shall be totally isolated from input voltage, cabinet ground, and other voltage outputs used to power the substation controller.

Remote I/O modules

Support for distributed architecture

Substation controllers designed along distributed processing principles are likely to have real-time data acquisition and control software that interfaces with actual field points installed on peripheral modules, rather than in the main processor unit. This is particularly the case where the peripheral I/O must be located away from the substation controller within the station's vicinity, and whose data then is multiplexed back to the substation controller serving as a sub-master.

The peripheral I/O modules provide specialized processing and storing/buffering functions for digital inputs, analog inputs, control outputs, analog outputs, pulse accumulator inputs and combinations of the above, by gathering data from field sources or acting as an output unit to interface with field devices.

The peripheral I/O modules are intelligent modules containing an on-board microprocessor and are configured as slaves to the substation controller's main processor. The specific I/O processing is distributed throughout the substation controller to the appropriate I/O module.

Digital Inputs

The substation controller shall support optional status input modules for collection and processing of digital input status signals from field devices.

Status input types

Substation controller shall support configuration of any status point in the database as one of the following status input point types:

- Status and alarm inputs
- Status inputs with change of state detection (COS)
- Sequence of events (SOE) using time-tagged COS
- Binary-Coded Decimal or parallel inputs
- Pulse accumulator or counter inputs
- Pulse duration inputs

Status input signals processing

Substation controller shall support, as a minimum, the following status signal processing features and functions:

- **De-bouncing:** De-bounce period shall be configurable in 1 millisecond steps from 4 to 250 milliseconds
- **Chatter filtering:** Method to reduce nuisance alarms caused by devices that may change state fairly quickly but do not need to be reported each time the state changes. Parameters shall be downloadable on a per point basis.
- **Report limiting:**
- **Scan frequency:** All status inputs shall be scanned at 1 millisecond intervals.
- **Electrical isolation:** Each input shall be optically isolated from controller internal electronics and capable of accepting DC inputs of any polarity
- **Field connections:** Status inputs shall support separate common connections minimum per group of 8 inputs. The field contact input to the substation controller is either a Form "A" or a Form "B" contact. The input circuitry shall be capable of accepting either a Form "A" or Form "B" contact as a normal condition, or as supported by the host protocol.
- **Momentary Change Detection (MCD):** The substation controller shall be capable of supporting momentary change detection (also referred to as status with memory) points; points with two states (alarm/normal, opened/closed, etc.) for which the present state and change history is reported. To provide detection between SCADA master station scan cycles, momentary change detection shall be software selectable for all digital input (DI) points. Between scans, each MCD point shall be capable of detecting and reporting at least two contact transitions for any contact input, in the order in which they occur.
- **Wetting voltages:** The following digital input wetting voltages shall be supported:
 - 24VDC
 - 48VDC
 - 110VDC
 - 220VDC

Wetting voltage selection shall be configurable through hardware jumper settings. Wetting voltage inputs shall be fused. Status digital inputs shall allow optional supply of contacts wetting from the substation controller or from an external power source:

- Contact wetting from on-board isolated supply at 24 V DC
- Capable of external wetting: 24, 48, or 130 VDC

- **Pulse Inputs (PI) – Accumulator Type:** Accumulator-type pulse inputs are used to collect and transfer totalized flow information to the master station on a periodic basis. The PI-accumulator points shall totalize pulses received from meters'-furnished dry contacts. A sensing voltage of not less than 24-volts shall be supplied from the substation controllers. As a minimum, each accumulator shall be capable of totalizing nothing less than 4,095 counts with an automatic "roll-over" capability. Each accumulator within the substation controller shall be able to accumulate any input occurring while the accumulator is being read, so that no input counts are lost. Each accumulator shall be capable of accepting counts at a maximum rate of 10 counts per second. The present count shall be transferred to a storage register on receipt of a FREEZE command.

Digital Outputs

The substation controller shall support optional control input modules for secure operation of control signals.

Digital Output Types

The substation controller shall support the following digital output types:

- Momentary (fixed)
- Trip/Close
- Raise/Lower
- Pulse Duration (variable).

Momentary (Fixed)

Each DO momentary control point shall comprise a paired control output consisting of an open output and a corresponding close output. These outputs shall be isolated from the substation controller internal logic. Separate control output relays shall be furnished for each OPEN and each CLOSE function.

These output relays shall close for a definite time interval upon an output command. The time interval shall be adjustable from 100 milliseconds to 12.75 seconds. The interval shall be accomplished by software on a point-by-point basis. These relays shall be de-energized in the event of substation controller malfunction.

The relay contacts shall be rated for at least 2 amps at 30 VDC, 60 VA. The relay contacts must be able to withstand the impression of at least 130 volts. These are used to drive the Customer supplied interposing relay in the Customer equipment bays. The contact arrangement for each output relay shall be Form "C". Each of the contacts shall be wired to terminal blocks for external wiring of each control output relay. (Customer shall define interposer relay requirements).

Latched

Provide options information as to latching output points' availability, compliance, and pricing based on hardware latching relay.

Each DO latched control point shall comprise a paired control output of an open output and a close output (set/reset). These outputs shall be isolated from the substation controller internal logic. The output relay shall be electrically or magnetically latched. These output relays shall transfer contacts upon an output command and shall maintain that condition until receiving a new command.

The relay contacts shall be rated for at least 10 amps at 28 VDC. The contact arrangement for each output relay shall be form "C".

Raise/Lower

Each DO raise/lower point shall comprise a paired control output of one raise output and one lower output.

These outputs shall be isolated from the internal logic of the substation controller. Separate control output relays shall be furnished for each RAISE and each LOWER function. It shall not be possible to perform a raise and a lower output simultaneously.

Each output relay shall close for a definite but adjustable time interval based on the command and closure time transmitted from the master station. The time interval shall be software adjustable from 100 milliseconds to 2 seconds. These relays shall remain de-energized in the event of substation controller malfunction.

Control signal processing

Substation controller shall support, as a minimum, the following control signal processing features and functions:

Contact rating: The relay contacts shall be rated for 2 amps at 30 VDC. The contact arrangement for each output relay shall be Form "A". Each of the contacts shall be wired to terminal blocks for external wiring of each control output relay.

Select-Check-Execute

Unless otherwise specified, all control operations shall incorporate select-check-execute transmission and single-point security. When a control point command is received, the substation controller shall arm the selected control point (separately encodes the address or the point that has been armed), and transmit the encoded address to the master station.

After selection (point arming), the substation controller shall automatically reset (cancel) the point within a predetermined time if it has not received a valid execute command transmission.

Any message that fails a comparison check or attempts to select more than one point shall initiate a control failure alarm and cancel the control actions.

After comparing the check-back message with the original command, the master station transmits an operate command. On receipt of operate command, substation controller energizes selected relay for specified period.

Each substation controller shall be equipped with a local/remote switch to disconnect the power to all digital output relays or otherwise inhibit all digital output points without shutting off the substation controller or otherwise affecting its operation. Each output relay module shall be optionally configurable to allow disabling of the module's output relays. An auxiliary contact shall be provided on each disable switch with all switches factory wired to one substation controller digital input point to provide remote indication of the switch(s) status. The required digital input point is included in the specified point count.

Analog Inputs

The substation controller shall support optional analog input modules for continuous collection and processing of DC analog voltage and DC current signals

Analog Input Types

The substation controller shall support the following analog input types:

- ± 1 VDC
- ± 5 VDC
- ± 10 VDC
- 0 to 1 mA
- -1 mA to 1 mA
- 0 to 5 VDC
- 4 to 20 mA
- 0 to ± 5 mA
- 0 to 5 mA

Analog input signals processing

Substation controller shall support, as a minimum, the following analog signal processing features and functions:

Signal conditioning

The A/D converter and associated signal conditioning shall meet the following minimum characteristics over a 0°C and plus (+) 60°C temperature range:

- Automatic self-calibration
- Full scale accuracy of $\pm 0.1\%$
- Linearity of 0.05 per cent full scale

Resolution

Fourteen-bit binary resolution or better; plus one sign bit.

Scan Rate

The substation controller must scan all analog inputs at a rate of at least once per second and support analog dead-band reporting limits.

Common-mode noise rejection

90 dB minimum, 0 to 60 Hz

Normal-mode noise rejection

60 dB minimum at 60 Hz.

Terminations

Two connections plus optional shield per input.

Loop Supply

Capable of being supplied at 24 VDC via on-board supply or externally, and be fused.

Calibration

The analog input subsystem shall recalibrate automatically to correct for any effects of temperature changes and component aging.

Report-by-Exception

The substation controller shall support report-by-exception with programmable dead-band for individual analog points, as supported by the host protocol. The substation controller shall use a separate analog reporting dead-band for each analog quantity to minimize data transfers to the Master. The most recent value of the sampled analog value must be compared to the reporting dead-band to determine if the value should be sent to the Master. This feature allows the analog quantities to be treated in a report-by-exception manner, thereby reducing the data transferred to the Master than would normally be transferred whenever a single bit change occurred as a result of the analog-to-digital process. The substation controller shall report the present value of all analog input points in response to an analog demand scan.

Analog Outputs

Substation controllers shall support optional analog outputs modules. Each analog output point shall consist of a digital-to-analog (D/A) converter and signal conditioning. The output of the analog output point shall settle to within ± 0.15 per cent of the digitally encoded value within 100 microseconds of an updated input. Overall accuracy of the D/A converters shall be ± 0.15 per cent of full scale over a minus 20°C and plus 60°C temperature range. Each analog signal output shall remain at its last set output level until a new value is sent for the point.

In the event of a substation controller malfunction, the analog outputs shall remain as last set.

SWC isolation must be available as an option.

Analog outputs are bipolar voltage or unipolar current outputs.

Support for Centralized or Distributed I/O

Input / Output Modules may be installed following a centralized or distributed substation automation topology. Communication between the peripheral modules and the D20MX shall support the following options:

- **RS485:** Generally, an RS-485 serial link is used for short distances, such as between I/O modules located close together on a rack or mounted in a group. Minimum distance for serial communications between peripheral modules and substation controller shall be 1000ft (300mts)
- **Fiber Optic:** Fiber optic links shall be used to extend the communications between the main processing unit and remotely located I/O modules or in electrically noisy environments. Minimum distance for Glass Fiber optic link shall be 6500ft (2000mts). Minimum distance for Plastic fiber optic link shall be 146ft (45mts).
- **Redundancy:** Dual communication links between the substation controller and the peripheral modules shall be supported.

- **Copper Ethernet:** The D20 Ethernet I/O modules network communication shall support **two redundant switched 10/100Base-T interfaces**, with RJ45 connections for category 5 UTP cable. i.e. two RJ45 connections for LAN 1 share the same MAC and IP address and another set of two RJ45 connectors for LAN 2 share another MAC and IP address. This shall be implemented with the following protocol when communicating with the D20MX:
 - DNP3 TCP/IP

D20E Ethernet I/O

- Shall support 1ms time stamp accuracy
- Shall support Pin to Pin connector compatible with D20 Classic I/O
- Shall support same form factor as D20 Classic I/O
- Shall have an updated electronic component
- Shall have a simplified design for improved reliability, single module simplified design
- Shall be equipped for new developments (additional protocols)
- Shall support Protection relay grade onboard relay 8A (300VDC / 4A continuous)
- Shall support (-40C+70C) humidity, vibration, shock & drop standards)
- Shall support Electro-magnetic compatibility - (IEC 61010-1; CE mark; UL/CSA for the future)
- Shall support insulation & isolation - (2800VDC; meets IEEE/IEC substation standards)
- Shall support isolation of inputs/outputs in the following manner:
 - All I/O and LANs shall have galvanically isolation.
 - Digital inputs shall be optically coupled
 - Control outputs relay shall be isolated.
 - Analog input subsystem shall be optically coupled.
 - LANs transformer shall be coupled.

Point Counts

Substation controller shall consist of a main processing unit with support for optional I/O peripheral and communication modules to support substation design scalability for small, medium or large substation designs based on a single controller and optional expansion modules. The table below present typical point counts for small, medium and large substations

	Main Processor	Digital Inputs	Control Outputs	Analog Inputs	Serial Ports	Ethernet Ports	202 Modem	System Points
Small Substation no I/O	1	0	0	0	7	2	2	Up to 5000
Small Substation with I/O	1	16	8	8	7	2	2	Up to 5000
Medium Substation	1	128	32	32	7	2	2	5000 to 15000
Large Substation	1	1280	320	160	21	2		15000 to 40000

SCADA Functions

Sequence-of-Events (SOE)

Based on a user's configuration, digital input points shall support sequence-of-events (SOE), in addition to the normal functions of the DI points. Substation controllers equipped with SOE points shall contain all necessary equipment to determine and time tag the order of occurrence of changes in the status of the external contacts. When a status change occurs, the event shall be identified with a point identification number, the type of event, and the time of occurrence in hours, minutes, seconds, and milliseconds, or as supported by the host protocol.

All SOE points shall function as standard digital input points. SOE capability shall be software assignable on an individual point basis.

At the time of occurrence, data associated with each event shall be stored in the substation controller memory for later transmission to the master station or retrieval locally at the substation controller. The substation controller shall retain SOE data until acknowledged receipt is received.

Time tags for substation controller inputs shall, as a minimum, have a 1 millisecond resolution. Changes shall be time-tagged to the nearest millisecond.

Input signals shall be filtered to eliminate noise and reject contact bounce. A digital filter is preferred for this application. The same filter characteristics shall apply to all SOE points.

Filtering shall be software adjustable in SOE points to provide enabling, and sensitivity adjustments.

The Vendor shall describe the method of chatter filtering, including characteristics of the filter and the time delay through the filter.

Each substation controller shall contain enough time-tagged sequential memory to store at least 1000 events.

Each substation controller that has SOE points shall maintain already held SOE data for at least one week with the substation controller power source out of service.

The Vendor shall submit a description of the method used to synchronize time at the substation controller. The submittal shall describe the type of signal and the rate at which this signal must be transmitted to maintain time synchronization, and compensation for different channel delays to the various remote locations.

Alarm Detection

The substation controller shall detect major malfunction (where practical) within itself, and lack of response from any attached configured Satellite substation controller or Serial I/O Device, or distributed elements.

The substation controller shall be capable of being programmed to provide off-line status information on any substation controller port communicating to intelligent end devices.

The SUBSTATION CONTROLLER shall provide access to alarm status information via the Maintenance Port.

Analog Averaging

The substation controller shall support a built-in automation application to calculate the average value of analog input signals. The averaging period shall be configurable on a per analog input point basis. The average periods shall be optionally configured relative to a top of the hour reference.

Programmable algorithms tool

The substation controller shall support IEC 61131 programming application to allow programming and development of logical, sequential algorithms into the substation controller. These algorithms shall use selected digital and analog I/O states. The Vendor shall be able to provide application development support and training services.

The substation controller shall be capable of being programmed to halt algorithm operation from the SCADA master station and the Maintenance Port.

The substation controller shall be capable of being programmed to perform logical and mathematical operations within the program on accumulator and input values, and store results in memory. The memory locations must be accessible to all programmed algorithms.

The substation controller shall be capable of storing multiple algorithms within the substation controller and activating selected ones at any time (programmed as subroutines within a single ladder).

Algorithms residing in the substation controller shall have access to the internal substation controller clock for controlling time sensitive operations.

Communications

Communication Ports

Serial communications

Each substation controller shall be able to support a minimum of eight communication ports. Seven of these ports shall be capable of supporting communications to peripheral devices such as multiple SCADA master stations, solid state meters, microprocessor based relays, satellite substation controllers and remote/local PCs; and the eighth port to be a dedicated maintenance port.

Each communication port shall be selectable to operate at 300 to 19,200 bits per second.

Each communication port shall function independently from other ports. Each port shall be minimally affected by simultaneous activity on other communication ports.

The number of communication ports shall be expandable to 35 ports.

Ethernet Communications

The Substation controller shall support the following:

- dual 10/100/1000BASE-TX Ethernet Ports (Isolated RJ-45 connector)
- dual 100BASE-FX Ethernet Ports (Fiber Optic: 1300 nm, 50/125 μm , 62.5/125 μm multi-mode duplex fiber cable, ST and LC connectors)

Modems

Two internal optional modems shall be furnished for each substation controller. One modem shall be configured for the SCADA master station port. The other modem shall be configured for future remote IED diagnostics and interrogation via a dial-up line.

The communication port to the SCADA master station modem shall have the following characteristics:

Field selectable for 2-wire or 4-wire operation. Full duplex modem operation in both modes is preferred, even when substation controllers will be operated using half-duplex protocols.

Data rate minimum 1,200 bits per second; capable of higher rate as communication medium permits.

Impedance (isolated) of 600 ohms \pm 10 percent.

Common mode isolation of 1000 volts AC or greater.

Transmit levels independently adjustable over a +5 to -30 dBm range.

The receive levels shall be independently adjustable over a +10 to -45 dBm range.

All modems furnished per application (maintenance port, SCADA master station port, etc.) shall preferably be of the same manufacturer, model, and type.

The modems shall utilize frequency shift keying, phase shift keying, amplitude modulation, or a combination of these. The transmit levels shall be independently adjustable over a +5 to -30 dBm range; the receive levels shall be independently adjustable over a +10 to -45 dBm range. Modem shall be industrially available, using standard modem communication methods, such as RS-485, RS-232, RS-422. Proprietary modems are not acceptable.

The communication interfaces shall perform necessary data format transformations (i.e. transform parallel word data to a serial bit string), and shall operate without apparent delay in information transfers. The failure of any communication interface shall not affect the operations of other communication interfaces.

Analog loop-back may be optionally provided. The modems include indicators for:

- Request-to-send
- Data carrier detect
- Received data
- Transmitted data

All modems shall be powered by the substation controller's power supply.

D20MX Currently Supported Applications

Note: * An Application ID containing an "N" (e.g., A009N) signifies a unique application definition for the D20MX.

† The D20MX version of the application is based on this D20 classic application version. However, the D20MX version is not identical to the D20 classic version due to minor changes to improve the robustness and security of the original application.

D20MX Application IDs*	Base D20 Classic Application Version†	Application Name	Description
D20MX v1.0			
A026-1	321	Communication Watchdog DTA	Reports on the state of communications between the RTU and a remote device.
A027N	832	SOE Logger DTA	Sequence of Events Logger DTA.
A030	300	Accumulator Freeze DTA	Detects system status point changes and system accumulator point freezes.
A033-5N	211	TEJAS V DPA	Valmet TEJAS V DPA.
A035	211	Analog Reference DTA	Monitors analog input points and provides the system database with pseudo analog values that represent either correctly functioning analog input hardware (good reference value), or failed analog input hardware (bad reference value).
A036N	421	ProLogic Executor DTA	Provides user programmable soft logic automation functionality.
A059N	912	Modbus DCA	Modbus (RTU & ASCII modes) DCA
A068N	311	Modbus DPA	Modbus (RTU & ASCII modes) DPA
A088-0	203	Substation Maintenance DTA	Allows status and analog input values to be suppressed for maintenance purposes.
A113N	301	PSR DCA	Programmable Synchrocheck Relay (PSR) DCA
A118	103	Failover DTA	Allows configurable combination of control requests to result in a failover or switchover of a redundant system.
A123-0	111	NGC General DTA	Generates control lockout indications, digital input suppression or unsuppression indications, and control active indications
A184-0	120	General Alarm DTA	Takes several alarms and groups them together under one General Alarm.
B003	751	D.20 Peripheral Link DCA	D.20 peripheral link DCA.
B008-1	311	System Point Database	Maintains the database of system points in the RTU
B009	401	Mailbox DTA	Mailbox system point conversion application
B012N	201	IRIG-B DCA	IRIG-B DCA
B013	560	DNP V3.00 Data Link	Distributed network protocol (DNP) V3.00 data link.
B014-1N	520	WESMAINT II+	RTU maintenance facility.
B015	530	Bridgeman	Bridge manager
B021N	994	DNP V3.00 DPA	Distributed Network Protocol (DNP) V3.00 DPA.
B023	755	DNP V3.00 DCA	Distributed Network Protocol (DNP) V3.00 DCA.

Product Bulletin

D20MX Application IDs*	Base D20 Classic Application Version†	Application Name	Description
B034N	203	Redundant Monitor	Monitors CCU states and initiates failover. Also, receives command requests to perform database synchronization, switchover and failover.
B045-0	101	D20AC WESMAINT II+ Display Screens	Provides D20AC WESMAINT II+ displays.
B052-0N	351	DNP Internet Data Link	DNP V3.00 Data Link over Internet.
B071-0	200	WESMAINT File Upload	Uploads files via the WESMAINT port as S records or using ZMODEM.
B100-0	141	Internet Protocol Stack	Internet Protocol Stack
B152-0N	n/a	IP Redundancy Monitor DCA	Provides health and active pseudo DI points for LAN Ports.
D20MX v1.1			
A083-0	342	Calculator DTA	Convenient and flexible soft logic utility that can perform applications such as substation level interlocking, feeder interlocking, and converting digital inputs to control outputs for driving a map board
D20MX v1.2			
A009N	805	PG&E DPA	Communicates to Master Stations via PG&E protocol
A078N	610	SEL DCA	Communicates to IEDs via SEL protocol
A101-0N	906	IEC 60870-5-101/104 DPA	Communicates to Master Stations via IEC 101/104 protocol
A185-0N	304	LG 8979 DPA	Communicates to Master Stations via LG 8979 protocol
A199-0N	106	HR6000/XA-21 DPA	Communicates to Master Stations via Harris protocol
B058-0N	231	IEC 870-5 FT1.2 Primary Data Link	FT 1.2 primary data link configuration
B060-0	210	IEC 60870-5-101/104 DCA	Communicates to IEDs via IEC 101/104 protocol
B085-0	130	IEC 60870-5-101 Balanced Mode Data Link	IEC 60870-5 FT1.2 balanced data link
B086-0	131	IEC 60870-5-104 Data Link	IEC 60870-5-104 data link
D20MX v1.3			
A017N	131	DNP1 Data Link	Distributed Network Protocol (DNP) V1.0 Data Link Application. Required by the Quantum Meter Scanner DCA.
A018	120	Quantum Meter Scanner DCA	The Quantum Meter Scanner DCA obtains data from one or more Quantum Meters via the DNP interface.
A023N	423	CDC Type I DPA	The CDC Type I DPA emulates a CDC Type I RTU
A041-1	116	Proportional Integral Derivative (PID) Controller	The Proportional, Integral and Derivative (PID) DTA uses the generally-accepted industry standard for control of closed loop processes.
A131-0	131	MODBUS TCP/IP DCA	Provides an interface to Sub-Remote Units (SRUs) using the MODBUS protocol over the TCP/IP communication layer.

Product Bulletin

D20MX Applicati on IDs*	Base D20 Classic Application Version†	Application Name	Description
A135-0	110	MODBUS TCP/IP DPA	Provides communications with one or more master station using the MODBUS protocol over TCP/IP communication layer.
A195-0	110	Redundant I/O DTA	Provides I/O point redundancy.
B082-0N	311	LogicLinx Executor	The LogicLinx executor is responsible for executing PLC programs written using the LogicLinx PLC (IEC 1131-3 compliant) editor.
B099-0	113	SNTP Client	The Simple Network Time Protocol (SNTP) client application provides reasonably accurate and reliable time synchronization.
B148-0	104	Time Zone and DST Settings DTA	The Time Zone and DST (Daylight Saving Time) provides a time zone and DST information to other applications.
D20MX v1.4			
A048	210	Status Combination DTA	Provides one or more DI points, each of which provides an event-driven logical OR of a set of mapped system DI points.
A186-0	213	Western Power Distribution (WPD) DTA	Calculates power from monitored voltage, current, and phase angle. Also, performs time integrated analog averaging, relative to the top of the hour.
A193-0	302	Top of the Hour Analog Averaging DTA	Performs time integrated analog averaging, relative to the top of the hour.
A194-0	101	Cooper 2179 DCA	Monitors and controls Cooper devices using the Cooper 2179 protocol.
A104-0N	124	Alarm Grouping DTA for the D20MX	Provides DI points each representing a group alarm. The group alarm is generated when the number of DI points in the alarm state exceed the group threshold value.
A121-0	200	Automatic Frequency Selection DTA	Provides AI points each derived from an Automatic Selection Method (ASM). An ASM selects the highest priority valid frequency measurement from a group of AI points.
A161-0	301	Secondary Master Trip/Close DTA	Translates control requests into conventional trip/close operations in conjunction with secondary control operations to be used as a Secondary Master Trip or Close.
B080-0	214	IEC 60870-5-103 DCA	Monitors and controls devices using the IEC 60870-5-103 protocol.
B119-1N	103	LAN Redundancy Manager DTA	Provides health and active pseudo DI points for LAN Ports, as well as default gateway monitoring and advanced routing configuration.
D20MX v1.5			
A064N	110	Tap Position Indication DTA	Translates a digital input point from a range of status points into an analog input value.
A065N	202	CL&P DTA	The China Light and Power DTA performs miscellaneous functions as follows: Julian day/year download, Raise/lower operations, RTS time synchronization.

Product Bulletin

D20MX Application IDs*	Base D20 Classic Application Version†	Application Name	Description
A074N	120	PML 3710 DCA	Enables the D20MX to communicate with PML 3710 ACM power meters.
A098-0N	701	Courier DCA	Enables communication with Courier SRUs (predominantly GEC K-Bus protection relays).
D20MX v1.6			
A040-0N	310	Digital to Analog Value Conversion DTA	Converts Binary, BCD, Gray, Reflected Gray, and Reflected Petheric codes into analog values.
A081-0N	110	PSI Quad4+ DCA	Collects data and forwards controls to devices using the Process Systems, Inc Quad4+ Meter SCADA interface protocol. Supports multi-dropped devices over RS232 or current loop.
A119-0	110	Printometer DTA	Counts the positive (low to high) transitions and freezes and clears the accumulators every time it receives a timer signal.
A132-0	611	Automatic Voltage Control DTA	Provides an automatic tap change scheme which maintains the correct voltage at lower voltage busbars. Supports up to 12 transformers and 8 busbars per DTA instance.
A138-0	105	Automatic Voltage Control Transformer Simulator	This simulator is used to verify the functionality of the AVC application.
A147-BN	100	SINUAT 8FW 1024 (DPDM) DPA	Enables master stations to retrieve data and send controls using the SINUAT 8-FW 1024 Digit Pulse Duration Modulation (DPDM) protocol.
A206-0N	A064-1 v210	Tap Position Indication – Type 1 DTA	Monitors a set of digital input points or an analog input point. It will output a value to an owned analog input point that represents the new position of the tap. This application is based on the A064-1 D20ME application.
B046-0N	110	Comm Stats Display	Interfaces with the internal database to display user configurable communications statistics. Primarily intended for D.20 communications statistics provided through Accumulator points.
B062-0N	123	Data Display DTA	Updates remote Data Display Panels to display analog input and binary input information.
D20MX v1.7 (currently in development)			
A170-0	204	Analog Alarm DTA	It is designed to monitor analog input points that act as threshold alarms. Each alarm is asserted or cleared, depending on several conditions. In particular the threshold alarm is asserted when the monitored analog input crosses the alarm threshold and has not crossed back over the hysteresis threshold before the qualification time expires. The threshold alarm is cleared when the analog input goes below the configured hysteresis threshold.
A209-0N	A033-2 212	TEJAS V (2-byte address) DPA	Uses multi-port and multi-response schemes to communicate to Tejas V master stations.

Product Bulletin

D20MX Application IDs*	Base D20 Classic Application Version†	Application Name	Description
A060-1N	107	Tejas III Slave DPA	Uses multi-port and multi-response schemes to communicate to Tejas III master stations.
A156-0N	250	SES, 92 DPA	The SES-92 DPA is a custom software package that emulates SES-92 RTUs. It is able to communicate with multiple master stations, over redundant communication lines.
A117N	401	SES, 91 DPA	The SES-91 DPA is a custom software package that emulates SES-91 RTUs. It is able to communicate with multiple master stations, over redundant communication lines.
A086-0	810	Automatic Restoration DTA	The main function of the Automatic Restoration DTA is to provide an automated means of restoring power to unfaulted segments of a feeder that has been sectionalized to isolate a fault. This sectionalizing will often remove power from feeder segments that are not faulted but have experienced the fault current. The purpose of the AR DTA is to restore power to as many of those unfaulted segments as possible while maintaining fault isolation and without exceeding the capacities of alternate power sources and routes.
B121-0N	100	Secure DNP3 DPA/DCA (DCA available post 1.7)	This is an enhancement to already existing DNP DCA, DPA applications

D20MX v1.7 (currently in development) Features

Feature	Description
DNP3 DCA Multi-partition support	This enables D200 multi-node configurations to be converted to D20MX with multi-node configurations through the multiple partition. DNP3 DCA, DPA, DNP Serial DL B013, and Bridge Manager B015 shall be supported on all 5 partitions.
VAR API model	This allows VARs to create and port their own applications using a GE-supplied package including header and make files and a VxWorks SDK
IEC 60870-5-101/104 DPA/DCA	This supports a bitstring of 32 bit controls.
Simplified one-step upgrade using SGConfig	This supports upgrade of the D20MX firmware, HSP, and user partition from any D20MX version except 1.0 and 1.1.
Rear Ethernet copper-type ports	This supports the rear Ethernet copper type of ports.

Communication Protocols/Automation Applications

The substation controller shall be capable of communicating with multiple master stations and multi-vendor intelligent electronic devices. The following communication protocols shall be supported:

The database shall be capable of being partitioned such that the user is able to map points in the database in accordance with the protocols. This partitioning shall determine which points are accessible for control or data monitoring by each port, definable on a point-by-point basis.

Substation controller configuration tool

- A substation controller configuration tool shall be supplied with the substation controller to allow programming and modification of the device configurations. The Vendor shall provide all necessary hardware and software to allow the Customer to configure and program any substation controller function without the aid of the Vendor.
- The substation controller configuration tool shall allow the Customer to generate and store substation controller configuration data files containing all programmable substation controller parameters for all substation controllers furnished under this contract.
- The Configuration System shall allow downloading and uploading of configuration files with error checking via the Maintenance Port.
- The configuration software shall be compatible with Windows 7 operating systems.
- The configuration software tool shall provide the capability to program, download, debug and store programs created in the IEC 61311 programming tool mentioned in the SCADA functions section.
- The configuration software tool shall be able to print a set of substation controller documentation, including a list of all input and output assignments by physical termination board layout. The descriptions of the terminations shall correspond with the equipment labels supplied by the Vendor.

Maintenance/Commissioning Facility

Self-diagnostics

During initialization, memory self-diagnostics shall occur and then initialize the system hardware and various I/O devices.

Troubleshooting

Diagnostic tools shall be provided to allow users, via a PC, to: monitor functions, examine memory, perform communication port loop back tests, adjust modem communication port settings, check CPU usage, force data inputs/outputs to test and confirm accuracy of data, check for messages in the error log to correct problems, and check of Change of States and Sequence of Events.

Watchdog Task

Watchdog low-priority task shall send a reset signal to the watchdog timer circuit. As long as the circuit is reset every second, a re-boot of the substation controller system is prevented from occurring.

Hot swappable peripheral modules

Substation controller system shall support capability for removing any I/O circuit board, internal I/O cable, or external I/O cable, while the substation controller is powered up, without causing any disturbances to other I/O points, and without affecting the general operation of the substation controller. External I/O cable removal shall not be required when removing an I/O circuit board.

Field replaceable power supply

Substation controller power supply shall be field replaceable without the need to disconnect power or communications wiring.

Field replaceable CPU

Substation controller's CPU shall be field replaceable without the need to disconnect power or communications wiring.

Field upgradable firmware

The substation controller must be microprocessor-based; the substation controller firmware shall reside in a field upgradable flash memory.

Safe mechanical design

The substation controller shall be designed so that it is mechanically impossible to install a circuit board to a connector which could cause damage to the substation controller, send erroneous data to a SCADA master station, or inadvertently operate an output point.

Maintenance Port Function

The maintenance port shall require a user-defined password for access.

A substation controller maintenance port shall be available to allow users to configure the substation controller database and program any substation controller function without the aid of the Vendor.

The substation controller maintenance port shall be EIA RS-232 compatible.

The maintenance port shall not allow alteration of any resident software containing the rules of communications protocol.

The maintenance port shall be capable of communicating in a "local mode", a selectable switch to disable supervisory control from master computer.

The maintenance port shall allow downloading and uploading of all programmable substation controller parameters from data files generated by the substation controller configuration system described in the substation controller configuration tool section.

The maintenance port shall provide a command set to output a list of point assignments, with point descriptions, in order by scan group and by physical termination location.

The descriptions of terminations shall correspond with the equipment labels supplied by the Vendor.

The maintenance port shall provide the ability to monitor and change the real-time state of all types of digital and analog, input and output points.

The maintenance port shall provide the ability to monitor the status of the substation controller and indicate any alarm condition. By connecting a printer to a serial port, all, or a subset of, time tagged status changes can be printed locally as they occur. The log includes an alarm description, point number, and date and time to the nearest millisecond.

The maintenance port shall provide access to SOE data for individual points.

The maintenance port shall provide a command to "warm start" the substation controller. The "warm start" shall consist of operating the substation controller through all initialization and diagnostic routines which are performed during power-up.

An additional password shall be required for changing the state of any output point. The password shall not be echoed back to the connected terminal. The password shall be changeable only through the substation controller configuration tool.

Spare Parts

Vendor shall submit a complete list of recommended spare parts for a two-year operation.

Product Support

If you need help with any aspect of your GE Grid Solutions product, you can:

- Access the GE Grid Solutions Web site
- Search the GE Technical Support library
- Contact Technical Support

GE Grid Solutions Web Site

The GE Grid Solutions Web site provides fast access to technical information, such as manuals, release notes and knowledge base topics.

Visit us on the Web at: <http://www.gegridsolutions.com>

GE Grid Solutions Technical Support Library

This site serves as a document repository for post-sales requests. To get access to the Technical Support Web site, go to: http://sc.ge.com/*SASTechSupport

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Contact GE Grid Solutions Technical Support

GE Grid Solutions Technical Support is open 24 hours a day, seven days a week for you to talk directly to a GE representative.

In the U.S. and Canada, call toll-free: 1 800 547 8629.

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Modification Record

Version	Revision	Date	Author	Change Description
1.00	0	11-March-2014	K. Odetunde	Initial release.
	1	3-October-2017	K. Odetunde	Revised