



An Indra company

# NTX-220 Substation Controller



The NTX-220 Substation Controller, the mid-size version of the ACS NTX series substation systems, provides complete substation management functionality. It also adds the ability to interface to a very large amount of data from integrated IEDs, and to a medium to large amount of data from hardwired local I/O devices in the substation. The NTX-220 is designed with multiple 32-bit CPUs operating within a client/server architecture. NTX-220 clients (such as the NTX gateway to IEDs) provide data that is received and processed at the server level in the NTX master gateway supplying the virtual databases to the master. Multiple user-defined subsets of this data can also be transmitted to one or more master stations in the master's native protocol. A medium amount of local analog and digital inputs can be configured in the six input module motherboard slots available. With the addition of an external expansion card file, these inputs are expandable to the maximum of 12 analog or digital input modules. Control relay outputs are also expandable to 256 relay outputs per control system node, utilizing externally mounted control relay modules with varying voltage and current contact ratings available.



*NTX-220, front view*



*NTX-220, rear view*

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In order to take maximum advantage of the client/server model, the NTX-220 uses a distributed processing architecture. Multiple high-performance ARM9E 32-bit RISC microprocessors, each programmed to support specific functions, are linked together using a peer-to-peer type network. The ARM9E microprocessor-controlled, high capacity NTX quad-serial/Ethernet gateways make it an ideal, low-cost substation solution for data concentrator and protocol converter for small- to medium-sized transmission or distribution substation installation.

## Design features

- Distributed processing architecture, featuring multiple high-performance, ARM9E 32-bit microprocessors with DSP extension in a client/server, peer-to-peer type LAN
  - Embedded Linux operating system (not user-accessible, for secure operating conditions)
  - Legacy protocols from previous Connex/NTU models will be supported, based on demand.
  - Extended temperature range of -10 to 70°C (14 to 158°F)
  - Multiple Virtual RTU™ database mapping
  - Field-programmable; remotely configurable via Ethernet WAN/LAN
  - Sequence-of-events reporting with 1ms resolution
  - Built-in IRIG-B (unmodulated) Time Code Reader and GPS time reference (NMEA 0183) interface (optional external satellite clock/antenna required) or NTP time synchronization, supported via the Ethernet network
  - Optional IEC 61131 and 61499-compliant NTX Logic PLC that executes user-defined control and/or calculation algorithms
  - 2 USB channels: 1 for mini-USB to USB connections to the maintenance channel; 1 to support a thumb drive to update Flash firmware
  - Multiple 10/100 BaseT Ethernet with DNP or Modbus RTU protocol over TCP/IP or UDP client, server or multiples of both, with a high quantity of IP connections available per port
  - Euro card format (3U x 84HP; 19" W x 5.25" H x 12" D); mid-plane motherboard where the front modules contain the majority of the logic (network CPU nodes); the rear modules contain the corresponding terminations
- Multiple master/IED isolated communication serial interfaces (configurable per port for RS-232C, with or without flow-control, to external modems or fiber optics, or RS-485 for copper)
  - Achieve NERC CIP compliance with the use of built-in solutions
  - Deploy secure communications with DNP 3.0 SA v5

## Application and expansion

The NTX-220 can be used in a traditional centralized equipment rack- or floor-mounted cabinet. The base NTX-220 has a six-slot I/O motherboard, which supports any combination of these modules in the slots:

- up to six 16-point DC analog input modules
- up to six 32-point digital input modules
- up to six Bell 202 FSK modems

The I/O is expandable beyond the base 6-slot I/O motherboard using a separate analog and/or digital inputs NTX I/O - 12 input expansion card file(s) with 12 additional input module slots of the same card file dimensions. An NTX System Controller with termination provides a combination of router and dual-serial ports, with an Ethernet port as the base communications gateway. An NTX internal I/O network controller is piggybacked on the NTX System Controller for the 6 I/O slots, for external I/O up to 256 analog inputs, 256 digital inputs and 16 analog output channels. With the addition of a binary output controller that will utilize one of the 5 system motherboard slots, up to 256 external control relays can be equipped with both momentary (varying contact voltage/current ratings supported) and latching relays. The unit power supply and up to four additional NTX quad-serial/Ethernet port gateways (three with the binary output controller installed) can be incorporated in the card file mid-plane system motherboard—for a maximum of 18 isolated EIA561 RS-232/RS-485 RJ45 serial ports and 5 high-capacity 10/100 BaseT Ethernet ports. NTX Explorer software makes it easy to configure or expand the type and number of ports and protocols communicating with the master stations or IEDs, defining local I/O points, and/or other components.

## Technical specifications

### Card file

Card file dimensions	Complies with IEEE 1101/11 & IEEE 1011.10 standards; 84 HP wide x 3U high (19" W x 5.25" H x 12" D) for single Euro-card format modules, bottom wall- or 19" rack-mounted with front and rear access
Configuration	The full-size card file contains the power supply, a 5-slot node system mid-plane motherboard and a 6-slot I/O mid-plane motherboard

### System nodes

NTX System Controller	<p>One DNP3 or Modbus RTU over 10/100 BaseT TCP/IP or UDP Ethernet (RJ45), configurable as a server, a client, or multiples of both</p> <p>Includes two isolated RJ45 serial ports, each configurable as a primary protocol device, a secondary (DNP3, Level 2 certified) protocol device, or as a pass-through port from the WAN</p> <p>Maximum IP connections: 16</p> <p>One mini-USB maintenance channel port; one USB for thumb drive firmware updates</p>
Time clock	On-board UTC time/date clock, non-volatile; internal time code reader for unmodulated IRIG-B (with P1344 extensions) time synchronization; GPS clock time synchronization (NMEA 0183 protocol) with optional antenna, or NTP via Ethernet
I/O controller	<p>Mounted on the NTX System Controller; provides interfaces to the base (6) analog and/or digital inputs, with separate I/O controller, maximum external card file analog (256) and digital (256) inputs, as well as the DIN-rail-mounted analog outputs (16)</p> <p>Not installed where local I/O is not required</p>
Binary output controller	<p>Utilizes one of the five system node motherboard slots for external DIN-rail mounted relay modules for up to 256 relays (momentary or latching)</p> <p>Not installed where no local control outputs are required</p>
NTX quad-serial/ Ethernet gateway	<p>One DNP3 or Modbus RTU over 10/100 BaseT TCP/IP or UDP Ethernet (RJ45), configurable as a server, a client, or multiples of both</p> <p>Includes four isolated EIA561 serial ports with RJ45 connectors per quad serial/Ethernet gateway node, with expansion for up to four NTX quad serial/Ethernet gateway nodes</p> <p>Maximum IP connections: 64</p> <p>Multiple legacy and modern protocols supported</p>
Database capacity	14,000 data values per system controller and NTX gateway
Serial port connections	EIA561 RJ45 connectors
Ethernet connection	RJ45, with multiple client, server and multiples of both; IP configurable
Serial communication ports	<p>Isolated digital RS-232C DTE (with or without handshaking) or RS-485 serial interfaces, configurable per RJ45 port</p> <p>Optional external fiber optic transceiver</p>
Serial analog operation channel	Two- or four-wire (9600 baud with optional external modem; 1200 baud with optional



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Serial baud rate	internal Bell 202 modem. Includes radio keying with isolated PTT outputs. 300 to 115,200 bits per second, selectable per port
Alternate application	NTX Logic is a Programmable Logic Controller (PLC) application that runs on the NTX System Controller platform with termination module Firmware fitted with the Run-Time license NTU Logic supports all of the standard IEC 61131 and 61499 control program languages, as well as Flow Chart
IEC 61131/61499 languages supported	SFC: Sequential Function Chart      FBD: Function Block Diagram LD: Ladder Diagram                      ST: Structured Text IL: Instruction List                        FC: Flow Chart

## Local binary inputs<sup>1</sup>

Capacity	192 points, in groups of 32 inputs (for the available six base I/O module slots) 512 inputs maximum with an expansion I/O controller node and card file Digital inputs configurable per point as binary with time (SOE <sup>2</sup> ), binary without time (Status), or Form A or two consecutive as Form C counters
Scan period	1 millisecond
Resolution	1 millisecond
Change buffer	256 events
Debounce filter	Adjustable bounce filter; changed contact must be in the same state for configurable (0-25) consecutive millisecond scans on a per point basis
Chatter filter	If enabled, provides a chatter period of 0 to 65535 milliseconds and a chatter filter change limit of 1 to 32 changes; both configurable on a per point basis
Contact input sense mode	Non-invert or invert on a per point basis
Contact wetting	Standard isolated $\pm 28$ VDC supplied by NTX-220 power supply; 32 inputs per module; optional 48 or 130 VDC
Input current limits	8 mA closed contact; < 4 mA open contact
Input isolation	Optically isolated
Contact input connections	10 mm compression terminal blocks, accepting up to #12 AWG (2.5mm <sup>2</sup> ) wire
DA040310 term module dimensions	100 mm x 126 mm x ~90 mm (3.9" x 4.96" x ~3.54") with 34-pin header to 32 pole terminal block for each 16 digital inputs. Includes contact state LED indicators.
Mounting	35 mm DIN-rail mounted

## Local counter inputs<sup>1</sup>

Capacity	96 Form C or 192 Form A points utilizing the six base card file I/O slots, in groups of 1 input
Contact input	Configurable for count per contact transition or count per contact full cycle
Freeze command	From master station based on protocol or locally frozen by the real-time clock May be frozen (report on a freeze command) or running counts (report on a count change)
Counter register size <sup>2</sup>	Minimum of 16 bits

## Local DC analog inputs

Capacity	96 points, in groups of 16 inputs (for the available six base I/O module slots) 256 inputs maximum with an expansion I/O controller and card file
Analog inputs	Standard: $0 \pm 1$ mA Optional: 4–20 mA, $0 \pm 1.5$ mA, $0 \pm 2$ mA, $0 \pm 10$ mA, $0 \pm 5$ VDC, etc.
A/D resolution	16-bit
A/D conversion voltage	$0 \pm 5$ VDC; configurable for $\pm 1$ VDC, $\pm 2$ VDC, $\pm 10$ VDC
Analog accuracy	0.1%; $-10^\circ$ to $70^\circ\text{C}$ ( $14^\circ$ to $158^\circ\text{F}$ )
Multiplexing hardware	Differential—all solid-state (CMOS FET)
Common mode rejection	85 dB @ 0 to 60 Hz
Normal mode rejection	> 70 dB @ 60 Hz
Isolation between inputs	10 m $\Omega$
Analog input connections	10 mm compression terminal blocks, accepting up to #12 AWG (2.5mm <sup>2</sup> ) wire
AS545032 term module dimensions	100 mm x 126 mm x ~90 mm (3.9" x 4.96" x ~3.54") with DB25F to 24 pole terminal block for each eight analog inputs
Mounting	35 mm DIN-rail mounted



## External local DC analog outputs

Capacity	16 analog outputs, in groups of 1 channel
D/A resolution	16-bit
Analog outputs	Isolated 4–20 mA
Output impedance	25 m $\Omega$
Isolation	Galvanic
Analog accuracy	0.1%; $-10^\circ$ to $70^\circ\text{C}$ ( $14^\circ$ to $158^\circ\text{F}$ )
Analog output connections	10 mm compression terminal blocks, accepting up to #12 (2.5mm <sup>2</sup> ) wire
Mounting	35 mm DIN-rail mounted



## External control outputs

Capacity	Optically isolated 16 x 16 matrix drivers for up to 256 relays (in groups of 6, 8 or 16 relays)
Relay coil	24 VDC
Control sequence	Internal select-before-operate
Local/remote switch	Standard: rear termination module fitted switch
Contact interface connections	10 mm removable compression terminal blocks, accepting up to #12 AWG (2.5mm <sup>2</sup> ) wire Relays with 20 amp, 150 VDC rated contacts use #8 screw terminals suitable for #10 wire
Module dimensions	202 mm x 108 mm x ~90 mm (7.9" x 4.96" x ~3.54")
Mounting	35 mm DIN-rail mounted (20 amp @ 150 VDC panel-mounted)

<sup>1</sup> Binary inputs include binary with time (SOE), binary without time (Status/Alarm), and counter input points; <sup>2</sup> Protocol-dependent

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Momentary contact ratings	10 A @ 277 VAC (or 32 VDC) Optional: 10 A and/or 20 A @150 VDC
Latch relay contact ratings	10 A @ 277 VAC (or 32 VDC)
Contact closure times <sup>2</sup>	Selectable: 0.001 second increments



## I/O protection certifications

Inputs and outputs	IEEE SWC protected (certified to ANSI/IEEE C37.90.1-2002) Impulse voltage protected (certified to IEC 255-5 Standards)
NERC CIP Compliance	Fully complies with the NERC CIP Version 5.2 requirements

## Power requirements

Power supply mounting	Internal card file module; combines the various input voltage pre-regulator and 5 VDC logic supply into a single package
Input voltage	24 VDC, 48 VDC, 125 VDC, 250 VDC, 120 VAC, 230 VAC Tolerance range: $\pm 15\%$ minimum
Power Supply Redundancy	Using the full size 19" wide card file, the NTX-200 can support redundant power supplies using the same input voltage, or any two AC or DC power supplies may be used. The customer can determine which power supply source is primary and which is considered secondary.
Power consumption	20 watts, typical
Power supply certifications	Internal noise < 1.5% of input voltage (certified to IEEE Standard C37.1-1994) Input voltage range > $\pm 15\%$ nominal (certified to CFE U0000-11)
Optional battery charger	Sealed lead-acid; 6 hours backup, typical
Backup with AC	Automatic no-break failover

## Enclosures

Enclosure ratings	Various sizes NEMA 12 (indoor) or NEMA 4 (outdoor) cabinets
Rack mounting	19" rack mounting or bottom card file panel mounting (with module removal clearance) DIN-rail mounted analog and digital input terminal block modules, control output modules, (20 amp, 150 VDC relay modules are panel-mounted), analog output modules. RS-232/RS-485 serial port interface cables/TBs. Optional bottom mounting.
Access	Front/rear card file access

## Operating range

Operating temperature	-10° to 70°C (14° to 158°F)
With heater option	For operation down to -30°C (-22°F)
Humidity	10% to 95% non-condensing

## NTX Explorer Configuration and Monitor software

User interface	Keyboard- and mouse-driven menus & views emulate Microsoft® Windows® Explorer
Platform	Portable PC, IBM-compatible
Operating system	Windows XP/WIN7/WIN8/ WIN 10
Accessibility	File transfer from the PC to the NTX or from the NTX to the PC via a micro-USB serial connection to the NTX USB maintenance port
PC serial interface	Mini-USB to USB interface port cable
Monitor parameters	Input and output state/values; control relay or IED tests, selective tracing of internal network traffic. Manually modify analog, counter or binary data values for on-line simulation testing of all inputs. On-line IED communication statistics. Enabled for either local or remote WAN access; can be disabled by the customer

## Miscellaneous options

Custom enclosures, with or without optional heater	Other external terminal block options
Bell 202 or 9600 baud 4-wire multi-drop telephone modem	External GPS satellite clock and antenna
35 mm DIN-rail, in 2-meter lengths	RS-232 RJ45 to 25-pin interface cables
RS-485 RJ45 to 8 terminal block assembly interface cables	RS-232 RJ45 to 9-pin interface cables

## Protocols

Master and IED protocol compatibility expands constantly. Visit our web site for a complete and up-to-date list.

## NTX Explorer Configuration and Monitor software

The NTX Explorer and Monitor programs work on a personal computer using the Microsoft® Windows® (XP, WIN7, WIN8, and WIN 10) operating system. It emulates the standard PC Windows Explorer file management system in order to minimize special training requirements. Drag-and-drop techniques are employed for database-mapping. NTX Explorer is used for configuration of the unit; in the field or the convenience of your office. Using Ethernet links to the NTX-220 provides an easy way to remotely download or upload a configuration to or from the NTX-220 via the WAN. Configuration parameters include baud rate, Virtual RTU addresses, modem type, local I/O configurations, etc. All configuration changes can be made independently, stored in a file on the PC, and downloaded to the NTX-220 when it is convenient. Configuration in an NTX-220 can also be uploaded to a PC.

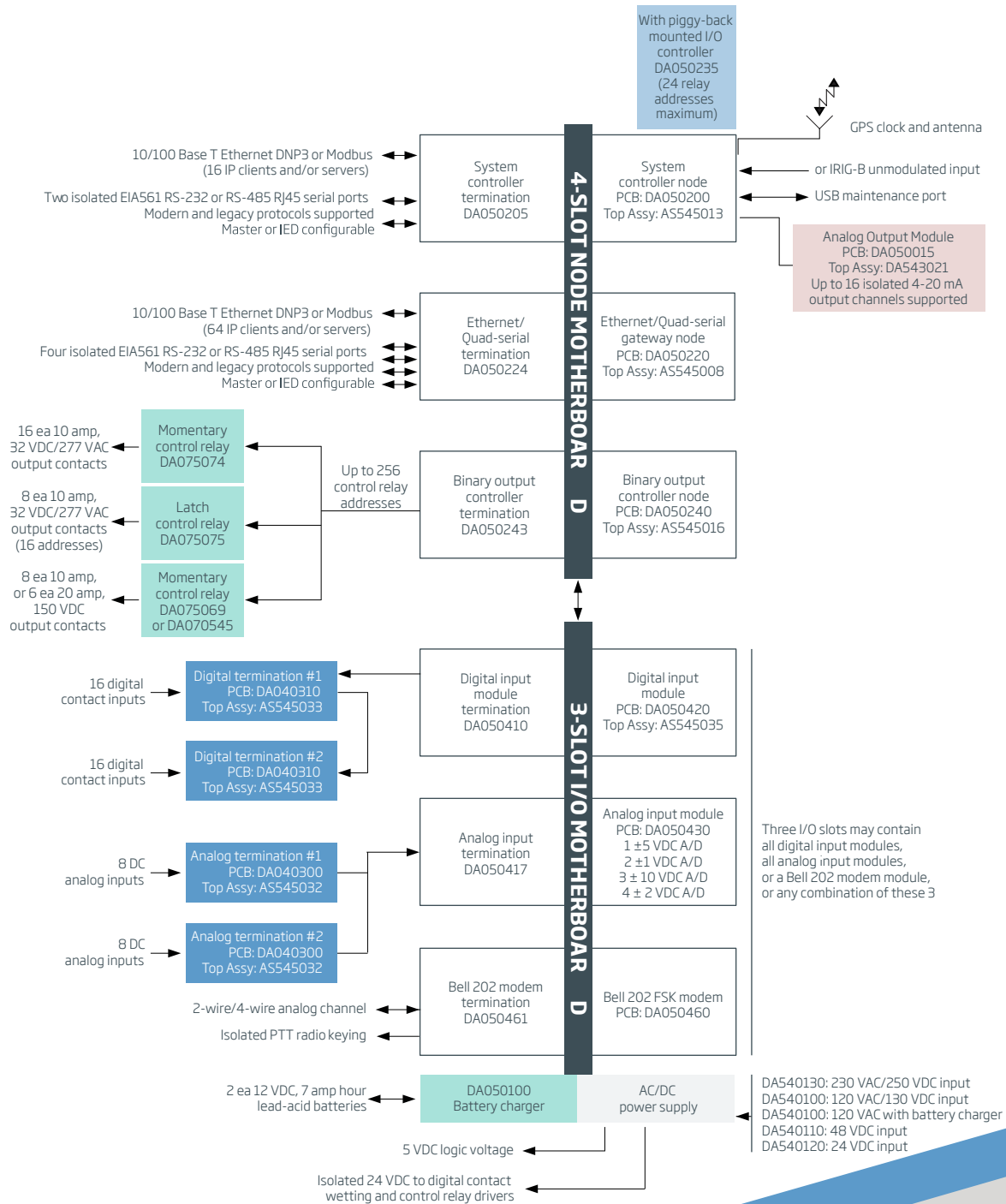
NTX Monitor is used for field diagnostics. It is used to display real-time data and functions such as binary and counter inputs, SOE data, analog points, IED inputs and outputs, state and activity of the binary output system, and internal LAN traffic. Local and IED control points can be tested directly in NTX Monitor. It is helpful in troubleshooting IED communications (through the monitor of communications statistics for each connected device) and application problems.

Monitored local input data can be modified manually by a technician for testing or database verification purposes. Monitored data has two quality flags associated with each data value in the database:

- data that is not updating from the external source (off-line IED, etc.) is displayed with a grey background
- manually modified data is displayed with a red background

With a 10/100 BaseT Ethernet interface to the NTX-220, NTX Explorer can be connected via a WAN for remote configuration.

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