



PRODUCT DATA SHEET

ACE3600 REMOTE TERMINAL UNIT



SECURE, REAL-TIME PROCESS AUTOMATION AND ROBUST COMMUNICATION

ACE3600 REMOTE TERMINAL UNIT

Supervisory control and data acquisition (SCADA) systems are continuously relied on to support the most demanding industrial applications and keep your operations running efficiently. Keep your assets connected to enhance productivity and safety across your operations with the ACE3600 Remote Terminal Unit (RTU).

The ACE3600 aims to make automation and monitoring of your complex processes robust and cohesive by connecting across a variety of communication media and data processing protocols. Enhanced security features also ensure your operations aren't compromised and productivity doesn't cease.

Modular design and abundant customization enables the ACE3600 to fit your specific SCADA needs. You can start small and grow, confident that the powerful processor can handle complex applications and keep your operations connected even as your needs or technologies evolve.

KEY BENEFITS:

- High-performance, real-time processing for complex control and automation applications
- Robust communication media and protocol support for greater interoperability
- MDLC protocol support for more efficient data communication over narrowband or broadband
- Enhanced security features internationally tested and certified

HIGH-PERFORMANCE, REAL-TIME PROCESSING POWER

Whether caused by a storm, theft or just aging infrastructure, disruptions to performance and the inability to pinpoint abnormalities decreases your productivity and can put personnel in harm's way. The ACE3600's processing power provides accurate data analysis and communication for the most critical, and demanding SCADA applications to ensure optimal operation.

A 32-bit processor, running at 200 MHz, delivers real-time processing with support for two 110 I/O modules, while the substantial Flash and DRAM memory capacity provides plenty of storage for alarms, events, live data, historical reports and files. Both polling and event-based reporting are supported, peer-to-peer or RTU-to-host.

The ACE3600 can also be redundantly configured with a simple Ethernet interconnection. This ensures continuous operation if one CPU or power supply were to fail.

VERSATILE COMMUNICATIONS CAPABILITIES

You want every opportunity to save money and optimize performance. The ACE3600 RTU is designed to use a variety of digital and analog interfaces so you are never locked into proprietary solutions. This flexible communications capability enables the ACE3600 to connect with several local devices, analyze the data and send that information to various other locations. Data transmission and processing is supported simultaneously across multiple communication media and industry standard data protocols including MODBUS, M-OPC DNP 3 and IEC60870-5-101.

Motorola's own MDLC data processing protocol is specifically designed to enable more efficient data communication. Transmit data over your narrowband radio network or utilize a broadband network and realize significant data cost savings.

Furthermore, every RTU in your network can act as a communication node and/or a store and forward data repeater to extend radio frequency coverage and save you the much higher cost of a dedicated repeater.

ENHANCED SECURITY

Apply the same state-of-the-art security features that Motorola provides for military and critical enterprise networks to your SCADA systems.

The ACE3600 supports a full range of best-practice security options directly within the RTUs for a self-contained, autonomously secure system including:

Security Policy Enforcement – Define and install a single, coherent, system-wide set of security configurations in every RTU.

Built-In Firewall – Filter IP communications by port, direction, protocol and IP address.

Access Control – User authentication tools, executed at the RTU or at the system server, verify specific user access and determine if use is legitimate and allowed.

Role-Based Access Control – The system administrator defines job roles and assigns different permissions so that each user is authorized to access only the parts of the system required for his or her job.

Intrusion Detection System – While allowing legitimate traffic, the ACE3600 identifies unauthorized access activities like an attempt to alter an RTU program or drop unauthorized data packets. It blocks these activities, logs the events and sends a report to the system administrator.

Application Control Software – Also known as "whitelisting," this software blocks unauthorized applications and code on PCs and RTUs. ACE3600 firmware protects user programs with this technique, and ACE3600 configuration management tools on PCs are protected with McAfee™ Solidifier.

Encryption – An algorithm makes data readable only by a device with a specific key to decrypt the message. Data stored within the ACE3600 is also encrypted using a 256-bit AES (Advanced Encryption Standard), meeting FIPS-140-2 Level 1 requirements.

Unused Port Deactivation – Disable communication for any ports that are unused, closing a point of access that could be exploited by attackers.

Time-Window Commands – When an application generates a command, it assigns a time window; after the time expires, system components will not execute the command. This can prevent replicating errors and commands of questionable origin from affecting the network.



PRODUCT DATA SHEET
ACE3600 REMOTE TERMINAL UNIT

GENERAL SPECIFICATIONS

Frames (* Depth including module panel)	No I/O slots - PS and CPU modules only, wall mount	117 W x 209 H x 198* D mm (4.61" x 5.30" x 7.80"*), .95 Kg (2.1Lb)
	2 I/O slots - PS, CPU and up to 2 I"L modules	194 W x 244 H x 198 D- mm (7.64" x 9.61" x 7.80"), Approx. 1.6 Kg (3.56 lb)
	3 I/O slots - PS, CPU and up to 3 I"L modules	234 W x 244 H x 198* D mm (9.21" x 9.61" x 7.80" *), Approx. 1.9 Kg (4.19 Lb)
	5 I/O slots - PS, CPU and up to 5 I/O modules	314 W x 244 H x 198* D mm (12.36" x 9.61" x 7.80"*), Approx. 2.4 Kg (5.3 Lb)
	7 I/O slots - PS, CPU and up to 7 I/O modules	391 W x 244 H x 198* D mm (15.39" x 9.61" x 7.80" *), 3. Kg (6.6 Lb)
	8 I/O slots - PS, CPU and up to 8 I/O modules	435 W x 244 H x 198* D mm (17" x 9.61" x 7.80" *), Approx. 3.3 Kg (7.3 Lb)
I/O Expansion Frame	Number of I/O slots	3, 5, 7, or 8
	Default power supply	Expansion power supply
	Compatible power supplies	All except: 10.8-16V DC low-tier power supply
Metal Chassis	Large: For PS, CPU and up to 7 I.O slot frame, two radios and 6.5 or 10 Ah backup battery, wall mount, 448 W x 468 H x 200* D mm (17.64" x 18.43" x 7.88"*)	
	Medium: For PS, CPU and 3 I/O slot frame, one radio and 6.5 Ah backup battery, wall mount, 335 W x 355 H x 198* D mm (17.64" x 18.43" x 7.80"*)	
	Small: For PS, CPU, 2 I/O slot frame, 1 radio (or 1 accessory box), and 6.5Ah backup battery, wall mount, 264 W x 365 H x 200 D** mm (11.02" x 14.17" x 7.88"*)	
Housing	Large NEMA 4/IP65 painted metal - up to 7 I/O slot frame, two radios and 6.5 or 10 Ah, backup battery, 500 W x 500 H x 210 D mm (19.7" x 19.7" x 8.26")	Small NEMA 4/IP65 painted metal - up to 3 I/O slot frame one radio and 6.5 Ah backup battery, 380 W x 380 H x 210 D mm (15" x 15" x 8.26")
Power supply	10.8-16 V DC	18-72 V DC with 12 V smart battery charger
	10.8-16 V DC low-tier	100- 240 V AC, 50-60 Hz
	18-72 V DC	100- 240 V AC, 50-60 Hz, w/ 12 V smart charger
Backup Battery	6.5 Ah - Sealed Lead-Acid	10 Ah - Sealed Lead-Acid
Operating Temperature	-40 °C to +70 °C (-40 °F to 158 °F) Notes: (1) when using a metal housing option, the maximum operating temp. outside the housing is +60 °C (140 °F). (2) Motorola radios and ACT module operating temp. range is: -30 °C to +60 °C (-22 °F to 140 °F).	
Storage Temperature	-55 °C to +85 °C (-67 °F to 185 °F)	
Operating Humidity	5% to 95% RH @ 50 °C without condensation	
Mechanical Vibrations	Per EIA/TIA 603 Base station, Sinusoidal 0.07mm @ 10 to 30 Hz, 0.035 mm @ 30-60 Hz	
Operating Altitude	-400m to +4000 meter (-1312 ft to + 13120 ft) above sea level Note:100-240 V AC and 18-72 V DC PS operating altitude is -400m to +3000 meter (-1312 ft to + 6560 ft)	

STANDARDS

Safety	UL 60950-1:2001	IEC 60950-1
	CSA 22.2-60950-1	AS/NZS 60950
Emission	Emission standards per:	EN61000-3-2
	CFR 47 FCC part 15, subpart B (class A)	EN61000-3-3
	EN55022:2003 Class A	
Immunity	Immunity standards for industrial environments per EN50082-2 /IEC 61000-6-2	IEC 61000-4-5
	IEC 61000-4-2	IEC 61000-4-6
	IEC 61000-4-3	IEC 61000-4-8
	IEC 61000-4-4	IEC 61000-4-11

COMMUNICATIONS

Communication Ports	Up to 9 ports per CPU Serial - up to 4 x RS-232 ports Multi-drop – up to 3 x RS-485 ports USB - up to 2 x USB Host ports and 1 USB device port	Ethernet - up to 3 x 10/100 MB ports and 1 x 10 MB port Two-way radio/analog trunked radio - up to 2 x modem ports
Motorola Radio Support	Conventional radios - XPR5350, DM4400, Xir M8620, DGM5000 (DMR) Analog trunking radios – APX6500Li Digital trunking radios – APX6500Li (P25), MTM5200 (TETRA), XPR5350, DM4400, Xir M8620, DGM5000 (DMR)	
Third Party Support	Two way radios, data radios, TETRA radio (PD) Dial-up modems, cellular modems (dial mode & PD)	
Protocols	MDLC, TCP, UDP, IP, PPP, NTP, DHCP	
Third Party Protocol Support	MODBUS RTU: master on RS-232 / RS-485 / Ethernet, slave on RS-232 / RS-485 / Ethernet DF1 (Allen Bradley): master on RS-232 DNP 3.0 Plus: master & slave on RS-232 / RS-485 / Ethernet IEC 60870-5-101: slave on RS-232	
User Protocol (user program)	Possible on RS-232, RS-485 and Ethernet ports	

CPU 3680/CPU 3640 MODULES SPECIFICATIONS

Microprocessor	Freescale – Power PC II, MPC8720, 32-bit, extended communication capability, DMA and floating point calculation support, 200MHz clock	
Memory	3640: Flash: 16 MB DRAM: 32 MB SRAM plug-in board (optional): 4 MB	3680: Flash: 32 MB DRAM: 128 MB SRAM plug-in board (optional): 4 MB
Real-Time Clock	Full calendar with leap year support (Year, Month, Day, Hours, Minutes, Seconds) Time drift: max. 2.5 seconds per day (when power is on)	
SRAM and RTC Retention	3 V Rechargeable lithium backup battery	
Serial Port 1	Configurable RS-232C or RS-485 port: - RS-232C: A synch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS-485, multi-drop 2-Wire up to 230.4 kb/s	
Serial Port 2	RS-232C, Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface	
Plug-in Port 1	Supports the following Plug-In ports: - Radio Modem, DPSK 1.2 kb/s, FSK 1.2 / 1.8 / 2.4 kb/s, DFM 2.4/3.6/4.8 kb/s - RS-232, Sync/Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS-485, multi-drop 2-wire, up to 230.4 kb/s - Ethernet 10/100 Mb/s	
Plus-in Port 2	Supports the following Plug-In ports: - Radio Modem, DPSK 1.2 kb/s, FSK 1.2 / 1.8 / 2.4 kb/s, DFM 2.4/3.6/4.8 kb/s and - RS-232, Sync/Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS-485, multi-drop 2-Wire up to 230.4 kb/s - Ethernet 10 Mb/s	
Ethernet Port 1	10/100 Mb/s	
USB Host Port 1, 2 (3680 only)	Type A host full speed 12 Mbs ports (HU1 on left and HU2 on right) for MDLC over IP communication via the MotoTrbo digital mode radio system. For MotoTrbo radio only; No other USB devices or USB Hubs are supported.	
USB Device Port 1	USB device port, Type B connector (3680 only)	
Internal Port 1	Ethernet 10/100 Mb/s (for redundant CPU configuration) (3680 only)	
LEDs Display	4 CPU diagnostics LEDs, port status LEDs and user application LEDs	
Power Consumption	See ACE3600 Maximum Power Ratings below.	
Operating Voltage	10. 8 -16 V DC (from the motherboard connector)	
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)	
Weight	Approx. 0.38 Kg (0.84 Lb)	

12 V DC POWER SUPPLY MODULE (DEFAULT)

Input Voltage	10.8 - 16 V DC
Outputs	Motherboard connector (to CPU and I/O modules): equal to input voltage, max. 4 A AUX1A/AUX1B: equal to input voltage, max. 8 A, on/off controlled by user program AUX2A/AUX2B (configurable): equal to input voltage (default), max. 8A, or 3.3, 5, 7.5, 9 V DC $\pm 10\%$, max. 2.5A, on/off controlled by user program Note: max. 8 A total current consumption from all outputs
No Load Power Consumption	Max. 50 mA
Diagnostics LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12V control for DO modules
Input Protection	Internal Line Fuse, replaceable
Output Protection	AUX2A/B Short Circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.443 Kg (0.95 Lb)

12 V DC LOW-TIER POWER SUPPLY MODULE

Input Voltage	10.8 - 16 V DC
Outputs	Motherboard connector (to CPU and I/O modules): The same as input voltage / max. 4 A AUX1A/AUX1B: equal to input voltage max. 8A Note: max. 8 A total current consumption from all outputs
Input Protection	Internal Line Fuse, replaceable
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.4 Kg (0.9 Lb)

18 - 72 V DC POWER SUPPLY MODULES

Input Voltage	18 - 72 V DC
Total Power	18-72 V DC: Max. 60 Watt continuous, Max. 105 Watt peak @ 25% duty cycle
Outputs	Motherboard connector (to CPU and I/O modules): 13.2 V DC $\pm 20\%$, max. 4 A AUX1A/AUX1B: equal to input voltage, max. 8 A, on/off controlled by user program AUX2A/AUX2B (configurable): equal to input voltage (default), max. 8A, or 3.3, 5, 7.5, 9 V DC $\pm 10\%$, max. 2.5A, on/off controlled by user program Note: max. 8 A total current consumption from all outputs
Battery Charger	12 V Lead-Acid battery charger (in PS model with charger) Automatic charging of 6.5 or 10 Ah backup battery, battery temperature sensing, overcharging protection, battery capacity test and diagnostics, automatic battery switch-over
No Load Power Consumption	Max. 250 mA
Diagnostics LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12V control for DO modules and battery
Efficiency	80% typical, 76% with full load
In-rush Current	10 A maximum, for 2 mSec. Max, cold start at 25°C
Output Protection	AUX2A/B Short Circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 1 Kg (2.2 Lb)

AC POWER SUPPLY MODULES

Input Voltage	100-240 V AC, 50/60 Hz
Total Power	Max. 60 Watt continuous, Max. 105 Watt peak @ 25% duty cycle
Outputs	Motherboard connector (to CPU and I/O modules): 13.2 V DC \pm 20%, max. 4 A AUX1A/AUX1B user connectors: 13.2V DC \pm 20%, max. 8 A, on/off controlled by user program AUX2A/AUX2B: 13.2 V DC \pm 20%, max. 8A or 3.3, 5, 7.5, 9 V DC \pm 10% (configurable), max. 2.5A , on/off controlled by user program Note: max. 8 A total current consumption from all outputs
Battery Charger	12 V Lead-Acid battery charger (in PS with charger) Automatic charging of 6.5 or 10 Ah backup battery, battery temperature sensing, overcharging protection, battery capacity test and diagnostics, automatic battery switch-over
No Load Power Consumption	130 mA @ 220 V AC
Diagnostics LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12V control for DO modules and battery
Efficiency	80% typical @230 V AC, 76% typical @115 V AC (full load)
In-rush Current	25 A maximum, for 2 mSec. Max, cold start at 25°C
Power Factor	0.98 typical at 230 V AC, 0.99 typical at 115 V AC
Input Protection	Internal Line Fuse, replaceable
Output Protection	AUX2A/B Short Circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 1 Kg (2.2 Lb)

24 V DC PLUG-IN POWER SUPPLY

Input Voltage	10.8-16V (from I/O module)
Output	24V floating, max. 150 mA
Efficiency	75% typical
Protection	Automatic output shut down on over-voltage and over-current
Insulation	Input to output: 1500 V AC
Dimensions	78 mm W x 15 mm H x 68 mm D (3.1" W x 0.6" H x 2.7" D)
Weight	Approx. 0.04 Kg (0.09 Lb)

16/32 DI FAST 24 V MODULES

Total Number of Inputs	16 DI, 32 DI
Input Arrangement	Isolated groups of 16 inputs with shared common
Fast Counter Inputs	Inputs that can be used as fast counters: - All inputs in 16 DI module - First 20 inputs in 32 DI module
AC Input Frequency	45 – 65 Hz
AC Input Delay	Maximum 0.2 mS
Fast Counter Input Frequency	0 - 12.5 KHz, minimum pulse width 40 μ S
Max. DC Input Voltage	Max. \pm 40 V DC (relative to input common)
"ON" DC Voltage Range	+9 to +30 V DC, -30 to -9 V DC
"OFF" DC Voltage Range	-3 to +3 V DC
"ON" AC Voltage Range	10 to 27 V AC (RMS)
"OFF" AC Voltage Range	0 to 5 V AC (RMS)
Input Current	Max. 3.5 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps)
Counter Input Filtering	0 to 12.75 mS (Programmable in 0.05 mSec steps for inputs configured as high speed counters)
24 V DC Output	Supports optional isolated 24 V plug-in "Wetting" Power Supply (One in 16 DI, two in 32 DI)

PRODUCT DATA SHEET
ACE3600 REMOTE TERMINAL UNIT

Diagnostics LEDs	Status LED per each input, module error LED, Plug-In 24V status LED
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable & TB Holder	20 or 40 Wire cable with Terminal Block Holder connector, 26 AWG wires
Module Replacement	Hot swap replacement – module extraction/insertion under voltage
Input Isolation	2.5 k V RMS between input and module logic per IEC60255-5
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC, per IEC60255-5
Operating Voltage	10.8 -16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	16 DI: approx. 0.28 Kg (0.62 Lb), 32 DI: approx. 0.29 Kg (0.63 Lb)

16/32 DI FAST 24 V IEC 61131-2 TYPE II MODULES

Total Number of Inputs	16 DI, 32 DI
Input Arrangement	Isolated groups of 16 inputs with shared common
Fast Counter Inputs	Inputs that can be used as fast counters: - All inputs in 16 DI - First 20 inputs in 32 DI
Fast Counter Input Frequency	0 - 10 KHz, minimum pulse width 50 μs
Max. DC Input Voltage	Max. ±40 V DC
"ON" DC Voltage Range	+11 to +30 V DC, -30 to -11 V DC
"OFF" DC Voltage Range	-5 to +5 V DC
Input Current	6-10 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps)
Counter Input Filtering	0 to 12.75 mS (Programmable in 0.05 mSec steps for inputs used as high speed counters)
24 V DC Output	Supports isolated 24 V plug-in "Wetting" Power Supply (one in 16 DI, two in 32 DI)
Diagnostic LEDs	LED per each input status, module error LED, 24V Plug-In status LED
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable & TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Input Isolation	2.5 kV RMS between input and module logic per IEC60255-5
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC, per IEC60255-5
Operating Voltage	10.8 -16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	16 DI: approx. 0.28 Kg (0.62 Lb), 32 DI: approx. 0.29 Kg (0.63 Lb)

16 DI 120/230 V MODULE

Total Number of Inputs	16 DI
Input Characteristics	IEC 61131-2 Type 1
Input Arrangement	Two isolated groups of 6 inputs and one isolated group of 4 inputs.
AC Input Frequency	47 - 63 Hz
AC Input Delay	Maximum 25.0 mS
Max. DC Input Voltage	Max. ±264 V DC (relative to input common)
"ON" DC Voltage Range	+79.0 V DC to +264.0 V DC, -79.0 V DC to -264.0 V DC
"OFF" DC Voltage Range	-40 to +40 V DC
"ON" AC Voltage Range	79.0 to 264.0 V AC (RMS)
"OFF" AC Voltage Range	0 to +40 V AC (RMS)

PRODUCT DATA SHEET
ACE3600 REMOTE TERMINAL UNIT

Input Current	At 110VDC 1.0 to 3.0 mA At 230VDC 0.4 to 2.0 mA	At 110VAC > 2.0 mA RMS At 230VAC > 3.0 mA RMS
Input Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps), minimum effective filter value - 7.0 msec.	
Diagnostic LEDs	LED per each input status, module error LED	
User Connection	3 Terminal Blocks (5.00mm pitch), Maximum 14 AWG	
Cable & TB Holder	30 Wire Cable with Terminal Block Holder connector, 20 AWG wires	
Module Replacement	Hot swap replacement– module extraction/insertion under voltage	
Input Isolation	2.5 kV RMS between input and module logic per IEC60255-5	
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC	
Operating Voltage	10.8 -16 V DC and 3.3 V DC ±10% (from the motherboard connector)	
Power Consumption	See ACE3600 Maximum Power Ratings below.	
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)	
Weight	Approx. 0.367 Kg (0.80 Lb)	

8/16 RELAY OUTPUT MODULES

Total Number of Outputs	8 EE relay outputs 16 EE relay outputs	8 ML relay outputs 16 ML relay outputs
Output Arrangement	8 DO: 3 X Form C (SPDT) and 5 X Form A (SPST) 16 DO: 6 X Form C (SPDT) and 10 X Form A (SPST)	
Contact Voltage Ratings	Max. 60 V DC, or 30 V AC RMS (42.4 V peak)	
Contact Power Ratings	2A @ 30 V DC, 0.6A @ 60V DC or 0.6A @ 30V AC (resistive load)	
Relay Back Indication	Contact position - hardware back indication	
DO Frequency	Max. 10 Hz	
Diagnostics LEDs	LED per each output status, module error LED	
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG	
Cable & TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG	
Fail State	Configurable relay state on CPU fail: On, Off or 'last value'	
All Relays Disable/Enable	Selectable per module, controlled from the power supply	
Module Replacement	Hot swap replacement– module extraction/insertion under voltage	
Output Isolation	Between open contacts: 1kV, between contact and coil: 1.5 kV, between contact sets: 1.5 kV	
Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC60255-5, Insulation impulse 1.5 kV per IEC60255-5	
Operating Voltage	10.8 -16 V DC and 3.3 V DC (from the motherboard connector)	
Power Consumption	See ACE3600 Maximum Power Ratings below.	
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)	
Weight	8 DO: approx. 0.29 Kg (0.64 Lb), 16 DO: approx. 0.32 Kg (0.7 Lb)	

12 HV OUTPUT MODULES

Total Number of Outputs	12 EE relay outputs	12 ML relay outputs
Output Arrangement	12 x 1 Form A	
Contact Power Ratings	3A @ 250 V AC, 3A @ 30 V DC, or 0.20A @ 125 V DC (resistive load)	
Minimum Contact Load Current	10.0 mA @+5.00 V DC	
Maximum Switching Current	3.00 A	
Relay Back Indication	Contact position - hardware back indication	
DO Frequency	Max. 10 Hz (resistive load)	
Diagnostics LEDs	LED per each output status, module error LED	
User Connection	3 Terminal Blocks (5.00mm pitch), Maximum 14 AWG	
Cable & TB Holder	30 Wire Cable with Terminal Block Holder connector, 20 AWG wires	
Fail State	Configurable relay state on CPU fail: On, Off or 'last value'	
All Relays Disable/Enable	Selectable per module, controlled from the power supply	
Module Replacement	Hot swap replacement– module extraction/insertion under voltage	

PRODUCT DATA SHEET**ACE3600 REMOTE TERMINAL UNIT**

Output Isolation	Between output and module logic: 2.5 kV, per IEC60255-5
Insulation	Insulation resistance 100 M Ω @ 500 V DC per IEC60255-5 Insulation impulse 5 kV per IEC60255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC \pm 10% (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	approx. 0.423 Kg (0.90 Lb)

8/16 ANALOG INPUT MODULES

Total Number of Inputs	8 AI, \pm 20 mA 16 AI, \pm 20 mA	8 AI, \pm 5 V 16 AI, \pm 5 V
Input Configuration	Isolated (floating) analog inputs	
A to D Resolution	16 Bit (including sign)	
Input Accuracy	\pm 0.1% of full scale	
Input Sampling Time	10 mSec @ 50 Hz filtering	8.33 mSec @ 60 Hz filtering
Smoothing	Selectable input averaging: 1, 2, 4, 8, 16, 320, 64 or 128 samples (x10 mS)	
Permitted Potential Between Inputs	75 V DC, 60 V AC (RMS)	
Input Impedance	\pm 20 mA input: Rin < 250 Ω	\pm 5 V input: Rin > 1 M Ω
Crosstalk Rejection	Better than 80 dB between any pair of inputs	
Temperature Stability	Better than \pm 25 PPM/ $^{\circ}$ C	
Interference Suppression	Selectable 50 or 60 Hz filtering Common mode rejection > 80 dB	Differential mode rejection > 50 dB
24 V DC Output	Supports optional isolated 24V Plug-in Power Supply (one in 8 DI, two in 16 DI)	
Diagnostics LEDs	Overflow and Underflow LED per each input, module error LED, 24V Plug-In status LED The module Overflow and Underflow levels can be configured to: Current inputs: \pm 20mA/4-20 mA Voltage inputs: \pm 5 V/0-5 V/1-5 V	
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG	
Cable & TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG	
Module Replacement	Hot swap replacement— module extraction/insertion under voltage	
Input Isolation	1.5 kV RMS between input and module logic, per IEC60255-5	
Input Insulation	Insulation resistance 100 M Ω @ 500 V DC, per IEC60255-5	
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)	
Power Consumption	See ACE3600 Maximum Power Ratings below.	
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)	
Weight	8 AI: approx. 0.32 Kg (0.71 Lb), 16 AI: approx. 0.34 Kg (0.75 Lb)	

4 ANALOG OUTPUT MODULE

Total Number of Inputs	4	
Output Configuration	Isolated floating channels, each channel can be connected as 0 -20 mA or 0-10 V DC voltage	
D to A Resolution	14 Bit	
Output Accuracy	\pm 0.1% of full scale @25 $^{\circ}$ C	
Temperature Stability	Better than \pm 25 PPM/ $^{\circ}$ C	
Internal Settling Time	Max. 1 ms	
Output Load	Voltage: > 1.0 k Ω , < 1.0 μ f, Current: < 750 Ω (internal power source)	
Crosstalk Rejection	Better than 50 dB between any pair of outputs	
Interference Suppression	Common Mode Rejection: > 60 dB	
Output Protection	Voltage output: short-circuit current, max. 30 mA	Current output: No-load voltage max. 22 V DC
Diagnostics LEDs	Module Error LED, Voltage mode LED, Current mode LED, Calibration LED per channel	
User Connection	2 Terminal Blocks (3.5mm pitch), Maximum 18 AWG	
Cable & TB Holder	20 Wire Cable with Terminal Block Holder connector, 26 AWG	

PRODUCT DATA SHEET
ACE3600 REMOTE TERMINAL UNIT

Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Isolation	1.5 kV between output and module logic
Insulation	Insulation resistance 100 M Ω @ 500 V DC, per IEC60255-5
Operating Voltage	10.8 -16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	0.29 Kg (0.64 Lb)

MIXED 4 ANALOG OUTPUT 8 ANALOG INPUT MODULES

Total Number of I/Os	4 AO + 8 AI (AI: ± 20 mA or ± 5 V DC)	
I/O Arrangement	AO - each channel can be connected as 0 -20 mA or 0-10 V, AI - Isolated (floating) analog inputs	
AO D to A Resolution	14 Bit	
AO Accuracy	$\pm 0.1\%$ of full scale @25°C	
AO Temperature Stability	Better than ± 25 PPM/°C	
AO Internal Settling Time	Max. 1 ms	
AO Load	Voltage: > 1.0 k Ω , < 1.0 μ f, Current: < 750 Ω	
AO Crosstalk Rejection	Better than 50 dB between any pair of outputs	
AO Interference Suppression	Common Mode Rejection: > 60 dB	
AO Voltage Output Protection	Short-circuits protection, max. 30 mA (all other operating channels remain fully functional)	
AO Current output no-load voltage	Max. 22 V DC	
AO Isolation	1.5 kV between output and module logic	
AO Insulation	Insulation resistance 100 M Ω @ 500 V DC, per IEC60255-5	
AI A to D Resolution	16 Bit (including sign)	
AI Accuracy	$\pm 0.1\%$ of full scale @ -40°C to +70°C	
AI Sampling Time	10 mSec @ 50 Hz filtering	8.33 mSec @ 60 Hz filtering
AI Smoothing	Selectable input averaging: 1, 2, 4, 8, 16, 32, 64 or 128 samples (x10 mS)	
Permitted Potential between Inputs	75 V DC, 60 V AC (RMS)	
AI Input Impedance	± 20 mA input: Rin < 250 Ω	± 5 V input: Rin > 1 M Ω
AI Crosstalk Rejection	Better than 80 dB between any pair of inputs	
AI Temperature Stability	Better than ± 25 PPM/°C	
AI Interference Suppression	Selectable 50 or 60 Hz filtering, Common mode rejection > 80 dB,	Differential mode rejection > 50 dB
24 V DC Output	Supports one optional isolated 24V Plug-in Power Supply	
Diagnostics LEDs	AO - Voltage mode LED, Current mode LED, Calibration LED per channel AI - Overflow and Underflow LED per each input, 24V Plug-in status LED The module Overflow and Underflow levels can be configured to: ± 20 mA/4-20 mA or ± 5 V/0-5 V/1-5 V General - Module error LED	
AI Input Isolation	1.5 kV between input and module logic	
AI Input Insulation	Insulation resistance 100 M Ω @ 500 V DC, per IEC60255-5	
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG	
Cable & TB Holder	40 Wire Cable with Terminal Block Holder connector, 26 AWG	
Module Replacement	Hot swap replacement– module extraction/insertion under voltage	
Operating Voltage	10.5-16 V DC and 3.3 V DC (from the motherboard connector)	
Power Consumption	See ACE3600 Maximum Power Ratings below.	
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)	
Weight	Approx. 0.34 Kg (0.75 Lb)	

PRODUCT DATA SHEET

ACE3600 REMOTE TERMINAL UNIT

16/32 DIGITAL OUTPUT/DIGITAL INPUT MODULES (16/32 DO/DI)

Total Number of I/Os	16/32
I/O Arrangement	2/4 groups of 8 I/Os with shared common Each group can be configured to function as FET DO or dry contact DI
Counter Inputs	20 first inputs can be used as counter inputs
Counter Input Frequency	0 - 1 KHz, minimum pulse width 500 μ S
Max. DC Input Voltage	Max. 30 V DC (relative to input common)
Input "ON" Resistance	0-4 k Ω
Input "OFF" Resistance	\geq 50 k Ω
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Current	Max. 0.3 mA (when the input is shorted)
Input Filtering	0 to 50.8 mS (programmable in 0.2 mSec steps) Not relevant, minimum allowed is 1mSec
Counter Input Filtering	0 to 12.75 mS (programmable in 0.05 mSec steps) Not relevant, minimum allowed is 1mSec
Output Type	MOSFET
Output Voltage Range	5-30 V DC (user-supplied voltage)
DO Frequency	Max. 1 KHz (resistive load)
DO Output current	Max. 500 mA sink current (resistive load)
Output Fail State	Configurable output state on CPU fail: On, Off or 'last value'
Diagnostics LEDs	LED per each input/output status, module error LED
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable & TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Input/Output Isolation	2.5 kV between input/output and module logic
Input Insulation	Insulation resistance 100 M Ω @ 500 V DC per IEC60255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.25 Kg (0.55 Lb)

MIXED I/O 16DI + 4 DO + 4AI MODULES

Total Number of I/Os	16 Digital Inputs + 4 EE Relay Outputs + 4 Analog Inputs, \pm 20 mA 16 Digital Inputs + 4 ML Relay Outputs + 4 Analog Inputs, \pm 20 mA
I/O Arrangement	1 group of 16 DIs with shared common, 4 relay outputs - Form C, 4 isolated analog inputs
DI Counter Inputs	The first 12 inputs can be configured as fast counters.
DI Frequency	0 - 1 KHz
DI Fast Counter Frequency	0 - 5 KHz minimum pulse width 100 μ S
DI Max. DC Voltage	Max. 40 V DC
DI "ON" DC Voltage Range	+11 to +30 V DC, -30 to -11 V DC
DI "OFF" DC Voltage Range	-5 to +5 V DC
DI Current	6-10 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
DI Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps)
DI Counter Filtering	0 to 12.75 mS (programmable in 0.05 mSec steps for inputs configured as high speed counters)
DO Contact Voltage Ratings	Max. 60 V DC or 30 V AC RMS (42.4 V peak)
DO Contact Power Ratings	2A @ 30 V DC, 0.6A @ 60V DC or 0.6A @ 30V AC (resistive load)
DO Relay Back Indication	Contact position - hardware back indication
DO Fail State	Configurable relay state on CPU fail: On, Off or 'last value'
AI Resolution	16 Bit (including sign)

PRODUCT DATA SHEET**ACE3600 REMOTE TERMINAL UNIT**

AI Accuracy	±0.1% @ -40°C to +70°C
AI Sampling time	10 mSec @ 50 Hz filtering, 8.33 mSec @ 60 Hz filtering
AI Smoothing	Selectable input averaging: 1, 2,4,8, 16, 32, 64 or 128 samples (x10 mS)
AI max. Potential between AIs	75 V DC, 60 V AC (RMS)
AI Impedance	Rin < 250Ω
AI Crosstalk Rejection	Better than 80 dB between any pair of inputs
AI Temperature Stability	Better than ±25 PPM/°C
AI Interference Suppression	Selectable 50 or 60 Hz filtering, common mode rejection > 80 dB, differential mode rejection > 50 dB
Diagnostics LEDs	LED per each input/output status, module error LED, 24V Plug-in status LED
24 V DC Output	Supports one isolated 24V plug-in "Wetting" Power Supply
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable & TB Holder	40 Wire Cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Input / Output Isolation	DI: 2.5 kV RMS between input and module logic per IEC60255-5 DO: Between open contacts: 1kV, between output and module logic: 1.5 kV, per IEC60255-5 AI: 1.5 kV between input and module logic per IEC60255-5
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC60255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below. EE Relay on : 0.2 W typical (15 mA @ 13.8 V DC at PS) (Not including 24 V Plug-in Power Supply)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.31 Kg (0.68 Lb)

DO SBO RELAY MODULE

Total Number of Outputs	8 DO: 8 EE relay outputs 16 DO: 16 EE relay outputs
Output Arrangement	8 DO: 2 X Form A (SPST) - (two normally open contacts per DO) 16 DO: 6 X Form C (SPDT and 10 X Form A (SPST)
Contact Voltage Ratings	Max. 60 V DC or 30 V AC RMS (42.4 V peak)
Contact Voltage Power Ratings	2A @ 30 V DC, 0.6A @ 60V DC or 0.6A @ 30V AC (resistive load)
Relay Back Indication	Contact Back Indication: Indicating contact position
Relay Select Back Indication	Indicating relay selection before relay activation
DO Frequency	Max. 10 Hz
Diagnostic LEDs	LED per each output status, module error LED, Controlled DO LED Controlled DO LED states: a. OFF - 12V is not controlled b. ON - 12V is controlled and exists c. Blinking - 12V is controlled and does not exist
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	40-wire cable braid with Terminal Block holder connector, 26 AWG
All Relays Disable/Enable	Selectable per module, controlled from the power supply
Module Replacement	Hot swap replacement - module extraction/insertion under voltage
Output Isolation	Between open contacts: 1kV Between contact and coil: 1.5 kV Between contact sets: 1.5 kV
Insulation	Insulation resistance 100MΩ @ 500 V DC per IEC60255-5 Insulation impulse 1.5 kV per IEC60255-5
Operating Voltage	10.8 - 16 V DC and 3.33 V DC (from the motherboard connector)
Power Consumption	See ACE3600 Maximum Power Ratings below.
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.32 Kg (0.7 Lb)

PRODUCT DATA SHEET

ACE3600 REMOTE TERMINAL UNIT

EXPANSION POWER SUPPLY MODULE

Input Voltage	DC 10.8-16 V
Outputs	To Motherboard connector – +10.80 to +16.00 VDC, max. 4A To cascaded expansion power supply - +10.80 to +16.00 VDC, max. 8A
Over Current Protection	4.0 A (Slow blow fuse), protecting the expansion frame 8.0 A (Slow blow fuse), protecting the cascaded expansion power supply
Maximum Current via Power IN/ OUT Circuit	8.0 A (Slow blow fuse)
Over Voltage Protection	+17.00 ±1 VDC (protecting the expansion frame)
Absolute Maximum Voltage	+18.00 VDC
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.43Kg (0.94 Lb)

EXPANSION MODULE

Microprocessor	Freescall – Power PC II, MPC8720, 32-bit, 200 MHz Clock
Serial Port	RS232C Asynch, Full Flow Control port, up to 230.4 kb/s; used for STS only
Ethernet Port	10/100 Mb/s – connection to the main frame
LAN Cable	Category 5E shielded (FTP), up to 50 meter
LEDs Display	4 CPU diagnostic LEDs, Port status LEDs and Expansion Address LEDs
Power Consumption	See ACE3600 Maximum Power Ratings below.
Operating Voltage	10.8-16 V DC (from the motherboard connector)
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.38 Kg (0.84 Lb)

EXPANSION LAN SWITCH

Ethernet Port 1-8	8 on board 10/100 Mb/s Ethernet ports (Auto crossover)
LEDs Display	Error LED, Port status LEDs
Power Consumption	See ACE3600 Maximum Power Ratings below.
Module Replacement	Hot swap replacement – module extraction/insertion under voltage
Operating Voltage (from the motherboard connector)	10.8-16 V DC, 3.30 VDC +/-10%
User Connection (Ethernet Ports)	8 shielded RJ45 connectors
LAN Cable	Category 5E shielded (FTP), up to 50 meter
Operating Voltage	10.8-16 V DC (from the motherboard connector)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx 0.32 Kg (0.7 Lb)

PRODUCT DATA SHEET

ACE3600 REMOTE TERMINAL UNIT

ACE3600 MAXIMUM POWER RATINGS

The tables below list the typical maximum power consumption (at room temperature) for each of the ACE3600 RTU building blocks (CPU, Power Supply, I/O modules, radios, etc.) and the maximum peak power allowed for a fully loaded RTU, based on the housing type.

The values in the tables below are derived by using the power supply (AC: 100 to 240 VAC or DC: 18 to 72 VDC and 13.8 VDC) and have the power supply efficiency factor included in them.

Before deploying your RTU, add up the power consumption of all components of your system to verify that it is within the maximum peak power for your housing type. In systems with I/O expansion, consider all modules which consume power from their respective AC/DC main power sources when calculating the required power requirements.

Maximum Peak Power Allowed for Fully Loaded RTU

19" Rack (w/out metal enclosure)	100 W
Large NEMA metal housing (50x50 cm)	120* W
Small NEMA metal housing (40x40 cm)	105* W

Power Consumption per RTU Module

Module	Self Power Consumption, no active I/O (Watts)	Maximum Power Consumption, per active I/O (Watts)	Self Power Consumption, no active I/O (Watts)	Maximum Power Consumption, per active I/O (Watts)	Maximum Power Consumption, all I/Os, LEDs active (Watts)
	AC: 100 to 240 VAC DC: 18 to 72 VDC		Vin = +13.8 VDC		
Power Supply (maximum)	12.60	N/A	2.20 (156 mA) (12 VDC Power Supply Module ONLY)	N/A	N/A
Power Supply (Expansion)	0.0	N/A	0.0	N/A	N/A
CPU (3680/3640)	5.20	N/A	4.20 (304 mA)	N/A	4.00 (290 mA)
Expansion Module	5.20	N/A	4.20 (304 mA)	N/A	4.00 (290 mA)
Expansion LAN Switch	1.50	0.220	1.20 (87 mA)	0.176 (12.75 mA)	3.10 (225 mA) (x8 ports ON)
Digital Input Fast 24V (x16/x32)	0.100	0.100 (powered by internal 24V PS)	0.080 (5.8 mA)	0.100 (7 mA) (powered by internal 24V PS)	3.50 (254 mA) (x32 inputs ON powered by x1 internal 24V PS)
Digital Input Fast 24V IEC Type 2 (x16/x32)	0.100	0.230 (powered by internal 24V PS)	0.080 (5.8 mA)	0.230 (17 mA) (powered by internal 24V PS)	8.20 (594 mA) (x32 inputs ON powered by x2 internal 24V PS)
Digital Input 120/230V	0.100	0.015	0.080 (5.8 mA)	0.012 (1 mA)	0.524 (38 mA) (x16 inputs ON)
Digital Output ML Relay (x8/x16)	0.120	0.010	0.100 (7.2 mA)	0.008 (0.5 mA)	0.483 (35 mA) (x16 relays ON)
Digital Output EE Relay (x8/x16)	0.170	0.200	0.136 (10 mA)	0.160 (11.6 mA)	3.26 (236 mA) (x16 relays ON)
Digital Output ML Relay 120/230V	0.200	0.006	0.160 (11.6 mA)	0.005 (0.4 mA)	0.248 (18.0 mA) (x12 relays ON)
Digital Output EE Relay 120/230V	0.290	0.260	0.232 (17 mA)	0.210 (0.15 mA)	3.12 (226 mA) (x12 relays ON)
FET Digital Output/ Digital Input	0.120	DI = 0.014 (per input channel) DO = 0.014 (per output channel)	0.100 (7.2 mA)	DI = 0.011 (per input channel) DO = 0.011 (per output channel)	0.552 (40 mA) (x32 LEDs/ inputs ON)
Mixed I/O (DO ML +DI IEC Type 2)	0.480	DI = 0.250 (powered by internal 24V PS) DO = 0.010	0.384 (28 mA)	DI = 0.250 (powered by internal 24V PS) DO = 0.008	4.70 (341 mA) (x4 relays ON, x16 inputs ON, x4 AI ON, powered by internal 24V PS)
Mixed I/O (DO EE + DI IEC Type 2)	0.480	DI = 0.250 (powered by internal 24V PS) DO = 0.200	0.384 (28 mA)	DI = 0.250 (powered by internal 24V PS) DO = 0.160	5.50 (400 mA) (x4 relays ON, x16 inputs ON, x4 AI ON, powered by internal 24V PS)
Analog Output	1.10	0.600 (per output channel @20.0 mA)	0.880 (64 mA)	0.480 (35 mA) (per output channel @20.0 mA)	3.33 (241 mA) (x4 outputs sourcing 20.0 mA)

PRODUCT DATA SHEET

ACE3600 REMOTE TERMINAL UNIT

Module	Self Power Consumption, no active I/O (Watts)	Maximum Power Consumption, per active I/O (Watts)	Self Power Consumption, no active I/O (Watts)	Maximum Power Consumption, per active I/O (Watts)	Maximum Power Consumption, all I/Os, LEDs active (Watts)
	AC: 100 to 240 VAC DC: 18 to 72 VDC		Vin = +13.8 VDC		
Analog Input Current/ Voltage (x8/x16)	0.530	N/A	0.440 (32.0 mA)	N/A	0.870 (63.0 mA)
24V Floating Plug-In Power Supply (No load)	0.410	N/A	0.328 (24 mA)	N/A	N/A
24V Floating Plug-In Power Supply (externally loaded 150 mA)	4.80	N/A	3.84 (278 mA)	N/A	N/A

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