COMMANDER 501 Process Controller

Specification DataFile

- **PID control with easily programmed standard templates**
  – single loop, heat/cool, motorized valve, auto/manual station, indicator, analog backup
- **Clear process display and color-coordinated switches**
  – process visibility, ease of operation
- **Comprehensive input/output capabilities**
  – up to three analog inputs, two analog outputs, four relays and four digital inputs
- **Process security and plant safety**
  – loop-break alarm, processor watchdog, password-protection and intelligent power recovery
- **Unique Control Efficiency Monitor (CEM)**
  – two Autotune algorithms plus manual fine-tuning using CEM
- **PC configuration for ease of setup**
  – easy access to advanced features and standard settings
- **IP66/NEMA4X front face**
  – reliability in the harshest environments
- **RS485 MODBUS™ serial communication**
  – SCADA, PLC and open system integration

COMMANDER 501 – stand-alone controller in a short-case, 6 x 3 format for basic applications

ABB Instrumentation

COMMANDER 501

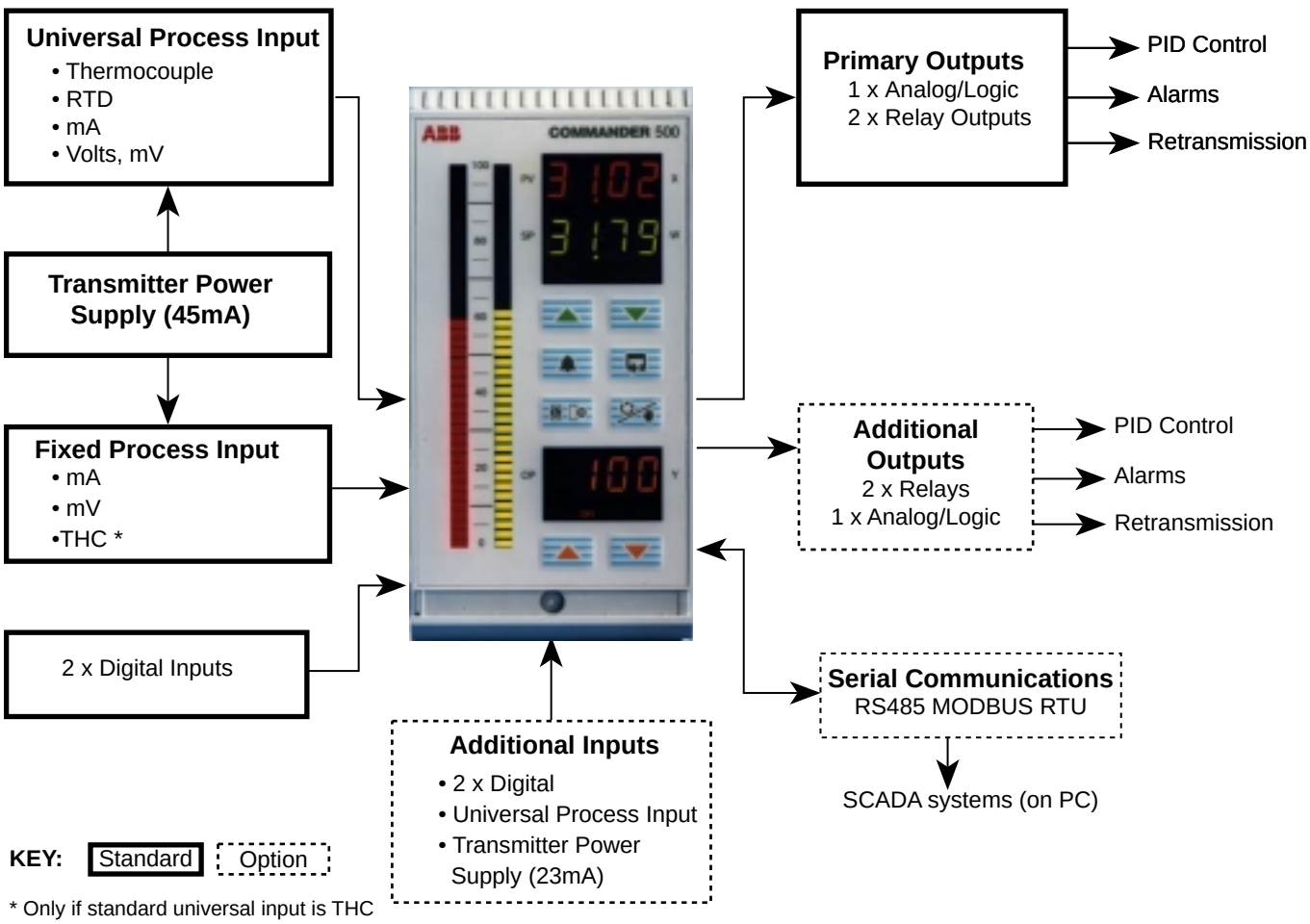
The **COMMANDER 501** is a versatile **single-loop controller** with advanced control features built-in as standard, e.g. gain scheduling, process optimization, alarm logic, maths and linearizers.

The instrument can be commissioned using a built-in library of **application templates** and advanced autotune facilities. Configurations can also be edited and stored off-line using our Windows™-based PC Configurator.

A wide range of process connections is included in the standard instrument; a choice of option cards provides additional input/output for complex applications. **MODBUS** serial communications are available for integration with factory automation systems.

IP66 (NEMA 4X) front panel protection makes the COMMANDER 501 an extremely robust controller, suitable for use in a wide variety of industrial environments.

Process Connections



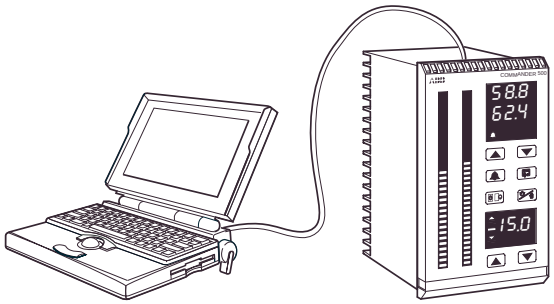
Process Visibility and Operation

Three high-visibility, colored digital displays show Process Variable, Set Point and Controller Output simultaneously. Dual, 40-segment bargraphs give an instant indication of process status. For clarity, function keys are color-coded to match their corresponding displays.

Eight individual tactile front panel keys make the controller very operator-friendly, with one-touch access to local/remote set point adjustment, alarm acknowledgment, auto/manual and output adjustment.

Secret-til-lit LED indicators display controller modes and alarm status, and provide extensive controller and plant diagnostics.

All of these features ensure that the controller is operator-friendly and no specific training is required for operational use.



Process Security and Self-diagnostics

To keep your process stable and secure, the COMMANDER 501 has intelligent diagnostics and responses, which can be used for process safety to initiate an action or to indicate a fault. A processor watchdog monitors the processor continuously; a unique loop-break alarm detects analog output failure; and there is an open circuit detector on the input. Using these signals, safety shutdown strategies can be initiated.

For configuration data security, there are three levels of password protection plus front panel function key lockouts, ensuring total process security.

Custom Linearizer

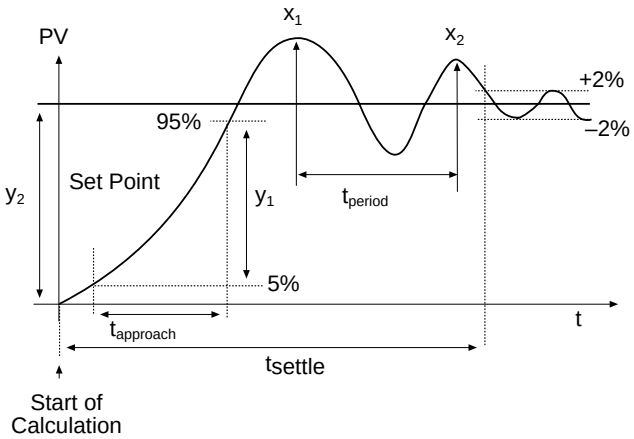
The COMMANDER 501 has two separate 15-breakpoint linearizers which can be programmed via the PC configurator and applied to either inputs or outputs. These can be used for non-standard thermocouples, non-linear tank levels or any non-linear input. The output linearizer accommodates any non-linear control elements.

Maths and Soft-Wiring

Four individual math blocks, each having up to 7 operators and operands, provide functions such as average, maximum and minimum calculations. Square root, relative humidity and arithmetic functions are also included as standard. Inputs can be selected or switched in and out of calculations by digital signals. This allows both simple and advanced calculations to be processed and these can be soft-wired to control functions.

Control Efficiency Monitor (CEM)

CEM measurements are designed to help you fine-tune your process manually. Six key-performance parameters are measured and displayed, allowing you to vary your PID settings to match the process needs and measure the results of your investment.



Out-of-the-Box and Installed-in-Minutes

The COMMANDER 501 has been designed to minimize your configuration and commissioning time, as you need only enter values that relate to your process. Application templates, offering preconfigured customized control strategies, allow rapid setup of the controller. Templates are selected via the PC configurator or the front panel keys. Alternatively the unit may be supplied preconfigured. Once a template is selected only three **key settings** are required and the **controller is ready-to-run**.

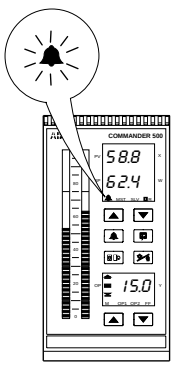
Complete configurations can be created, edited and stored off-line, using the COMMANDER PC configuration editor. A dedicated cable connects the PC to a jack socket on the top of the controller for rapid upload, or download, of configurations. Copies of the configurations can be saved and produced as hard copy.

A dual mode, intelligent autotune requires no prior knowledge of PID settings and offers a choice of fast response or minimum overshoot strategies.

Process Alarms

The COMMANDER 501 has eight internal process alarms. These can be soft-wired to control strategies, logic equations and output relays.

Each alarm can have a separate hysteresis value, programmable in engineering units or time. Alarms can also be enabled or disabled via digital inputs and can be configured as annunciators, so the alarm may be disabled once acknowledged.



Customized Application Templates

Templates are provided to make the basic configuration for a particular application as simple as possible. When a template is selected the COMMANDER 501 assumes the preset form for that template (see below). The inputs and software blocks are soft-wired automatically to perform the selected function.

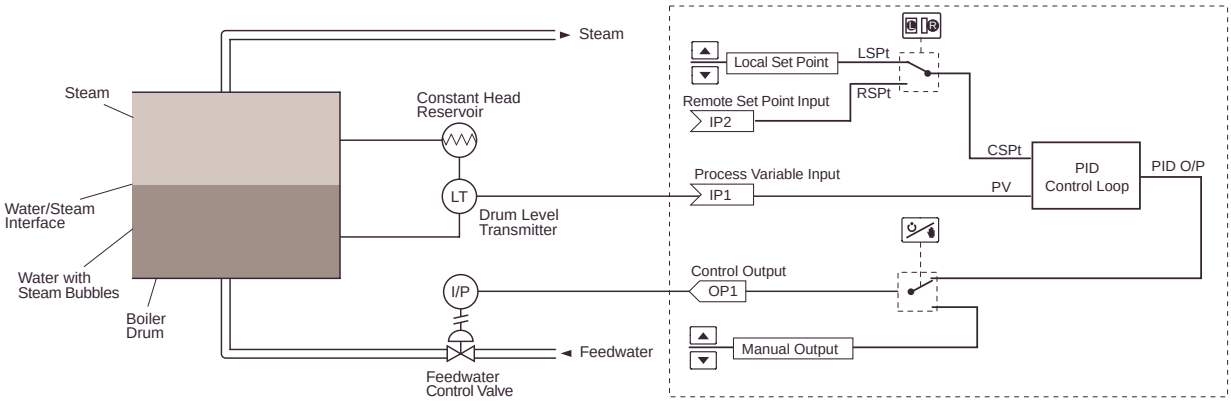
Configuration time is greatly reduced as 90% of the choices you would normally need to make in similar products are already preconfigured.

The COMMANDER 501 offers the following templates:

1 Single loop controller with local set point
2 Single loop controller with remote set point
3 Auto manual station (low signal detection)
4 Auto manual station (digital signal selection)
5 Analog backup station (low signal detection)
6 Analog backup station (digital signal selection)
7 Single indicator/manual loader station
8 Dual indicator/manual loader station

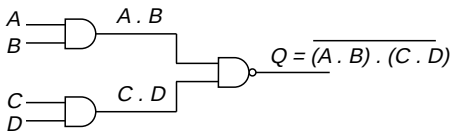
Single Loop Control Template – Example

A single element drum level is used in industrial boiler applications with slowly changing steam demand and/or constant BTU content fuel-fired boilers.



Sequencing and Logic Control

The COMMANDER 501 offers comprehensive sequencing, to complement its advanced analog control features, and six logic equations, with up to fifteen elements per equation. These logic equations, when combined with delay timers, real-time alarms and extensive I/O, make the COMMANDER 501 a powerful interlocking controller.



Intelligent Adjustable Power Recovery

Two forms of plant power failure recovery are available programmable between 0 and 9999s for recovery time:

'HOT' restart – if the power is restored within the recovery time the COMMANDER 501 defaults to Auto mode, allowing the process to be up-and-running without delay.

'COLD' restart – if the power is not restored within the preset recovery time, the controller defaults to Manual mode, or a predetermined control output. This ensures that after power failure the controller does not start to control the process without operator acknowledgment.

Industrial Robust Design

The front face has been designed to meet IP66/NEMA4X rating with a unique moulded case and panel seal. A chemical resistant polyester front panel ensures a secure investment for any environment.

SPECIFICATION

Summary

- 8 application templates: Single loop, Auto/Manual, Analog backup, Indicator
- Two Autotune options
- Control Efficiency Monitor
- PC configuration
- IP66/NEMA4X front face

Operation

Display

2 x 100mm 40-segment LED bargraphs
2 x 10mm 4-digit LED indicators
1 x 10mm 3-digit LED indicators
Display range: –1999 to +9999

Configuration

Basic configuration via front panel keys
Advanced feature configuration by PC only

Security

Internal security switch and password-protected menus

Standard Functions

Control Strategies

Single-loop, Auto/manual Station, Analog Backup, Indicator/Manual Loader

Output Types

Current proportioning, Time proportioning, On/off, Motorized valve (with and without feedback), Heat/cool.

Control Parameters

Four sets of PID settings, selectable via digital signals

Set Points

Local, remote and four local fixed set points, selectable via digital signals

Configured Outputs

Three preset output values, selectable via digital signals

Autotune

On demand for $^1/_4$ wave or minimal overshoot

Process Alarms

Number	8
Types	High/low process, High/low output, High/low deviation
Hysteresis	Level and time *
Alarm enable/disable	Enable/disable of alarms via digital signal

Real Time Alarms *

Number	2
Programmable	On time/day and duration

* Accessed via PC Configurator

Analog Inputs

Universal Process Inputs

Number

1 standard
1 optional

Type

Universally configurable to provide
Thermocouple (THC)
Resistance thermometer (RTD)
mV
Volts
mA
Resistance

Input Impedance

mA	100Ω
mV, V	10MΩ

Linearizer Functions

THC types B, E, J, K, L, N, R, S, T, PT100, √, $^3/_2$, $^5/_2$

Broken Sensor Protection

Programmable for upscale or downscale drive

Sample Interval

125ms (1 input)

Digital filter

Programmable

Cold Junction Compensation

Automatic CJC incorporated as standard
Stability 0.05°C/°C change in ambient temperature

Input Protection

Common mode rejection >120dB at 50/60Hz with 300Ω imbalance resistance
Series mode rejection > 60dB at 50/60Hz

Transmitter Power Supply

Number:	1 standard, 1 optional
Voltage:	24Vd.c. nominal
Drive:	Up to 45mA as standard, up to 23mA on option board

Non-universal Process Input

Number

1 standard
Input types
mA, mV only (THC only if IP1 is also THC)
Linearization B, E, J, K, L, N, R, S, T, √, $^3/_2$, $^5/_2$

EMC

Emissions

Meets requirements of EN50081-2

Immunity

Meets requirements of EN50082-2

Outputs

Control/Retransmission Outputs

Number	1 standard, 1 optional
Type	Programmable as analog or logic (digital) output
Isolation	Galvanically isolated from the rest of the circuitry
Analog range	0 and 20mA (programmable), accuracy: 0.25%
Digital voltage	17V @ 20mA

Relay Outputs

Number	2 standard, 2 optional
Type	SPST, rated 5A at 115/230V a.c.

Digital Inputs

Number	2 standard, 2 optional
Type	Volt-free
Minimum pulse	200ms

Advanced Features

Maths Blocks *

Number	4
Operators	+, –, x, ÷, Average, Maximum, Minimum, High select, Low select, √, Median select, Relative Humidity Input multiplexer (digitally selected)

Delay Timers *

Number	2

Programmable Delay and Duration in seconds

Logic Equations *

Number	6
Elements	15 per equation
Operators	OR, AND, NOR, NAND, NOT, EXOR

Custom Linearizers *

Number	2
Breakpoints	15 per linearizer

* Accessed via PC Configurator

Options

Analog Inputs

Number	1
Isolation	Galvanically isolated from the rest of the circuitry
Type	Universal (see above)

Analog/Digital output

Number	1
Isolation	Galvanically isolated from the rest of the circuitry
Type	Programmable 0 to 20mA analog or 17V @ 20mA digital

Relay Outputs

Number	2
Type	SPST, rated 5A at 115/230V ac

Digital Inputs

Number	2
Type	Volt-free
Minimum pulse	200ms

Serial Communications

Connections	RS485, 2- or 4-wire
Protocol	MODBUS RTU
Isolation	Galvanically isolated from the rest of the circuitry

Standard Analog Input Ranges

Thermocouple	Maximum Range °C	Maximum Range °F	Accuracy (% of reading)
B	–18 to 1800	0 to 3270	0.1% or ±1°C (1.8°F) [above 200°C (392°F)]
E	–100 to 900	–140 to 1650	0.1% or ±0.5°C (0.9°F)
J	–100 to 900	–140 to 1650	0.1% or ±0.5°C (0.9°F)
K	–100 to 1300	–140 to 2350	0.1% or ±0.5°C (0.9°F)
L	–100 to 900	–140 to 1650	0.1% or ±1.5°C (2.7°F)
N	–200 to 1300	–325 to 2350	0.1% or ±0.5°C (0.9°F)
R	–18 to 1700	0 to 3000	0.1% or ±0.5°C (0.9°F) [above 300°C (540°F)]
S	–18 to 1700	0 to 3000	0.1% or ±0.5°C (0.9°F) [above 200°C(392°F)]
T	–250 to 300	–400 to 550	0.1% or ±0.5°C (0.9°F)

RTD	Maximum Range °C	Maximum Range °F	Accuracy (% of reading)
PT100	–200 to 600	–325 to 1100	0.1% or ±0.5°C (0.9°F)

Linear Inputs	Range	Accuracy (% of reading)
Millivolts	0 to 500 mV	0.1% or ±10µA
Milliamps	0 to 50 mA	0.2% or ±2µA
Volts	0 to 5V	0.2% or ±2mV
Resistance	0 to 5000Ω	0.2% or ±0.08Ω

Notes.

Performance accuracy is not guaranteed at extreme low end of thermocouple and sq. root ranges.
RTD, 3-wire platinum, 100Ω per DIN 43760 standard (IEC751), with range of 0 to 400Ω.

Min. span below zero	Type T 70°C/126°F Type N 105°C/189°F
THC standards	DIN 43710 IEC 584
RTD standards	DIN 43760 IEC 751

Physical

Size

76mm x 148mm x 149.5mm
(2.99 in. x 5.83 in. x 5.87 in.)

Weight

750g (1.6lb)

Electrical

Voltage

85 to 265V a.c. 50/60Hz
24V d.c.

Power consumption

<10VA

Power interruption protection

Up to 60ms

Safety

General safety EN 61010-1

Dielectric Strength

500V d.c. to earth:
Analog/digital output 1 to rest of the circuitry (500V d.c. for 1 minute)
Analog/digital output 2 to rest of the circuitry (500V d.c. for 1 minute)
Analog input 3 (IP3) to rest of the circuitry (500V d.c. for 1 minute)
Serial communications to rest of the circuitry (500V d.c. for 1 minute)

Environmental

Operating Limits

0°C to 55°C (32°F to 130°F)
5 to 95%RH (non-condensing)

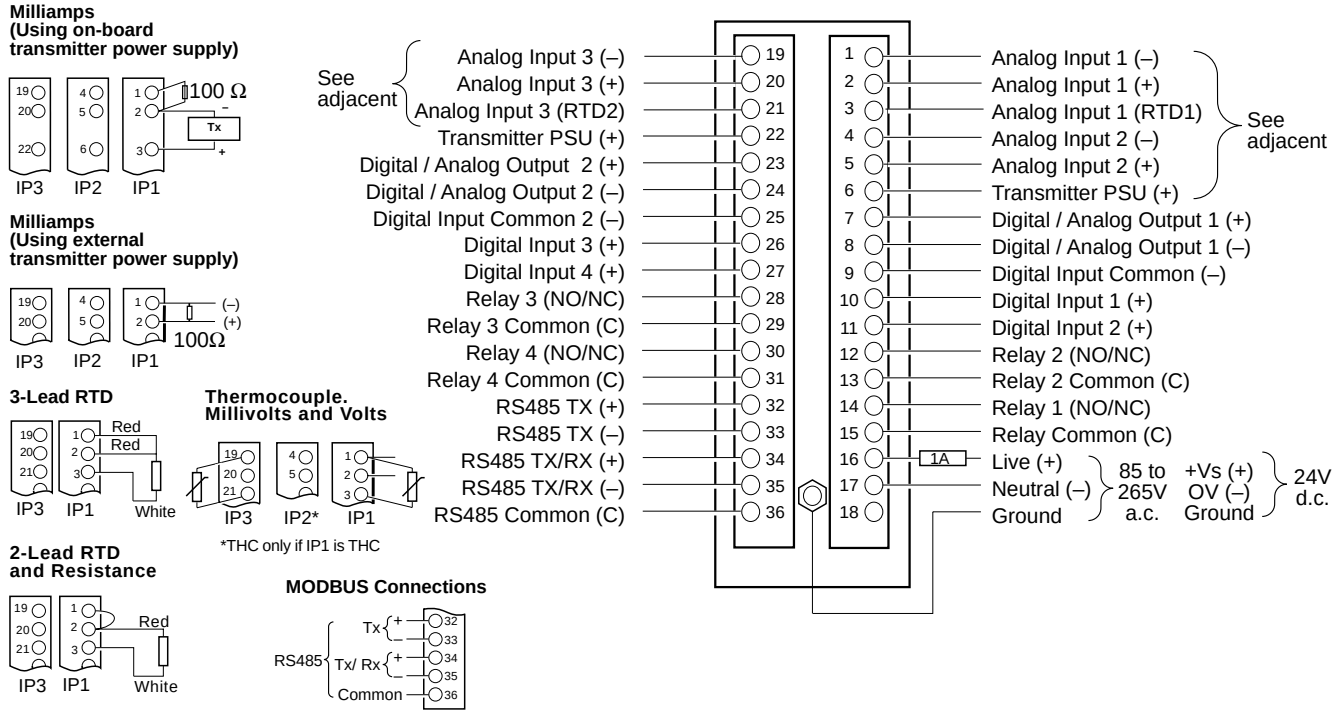
Temperature stability

<0.02%/°C or 2µV/°C (<0.011%/°F or 1.11µV/°F)
Long term drift <0.02% of reading or 20µV annually

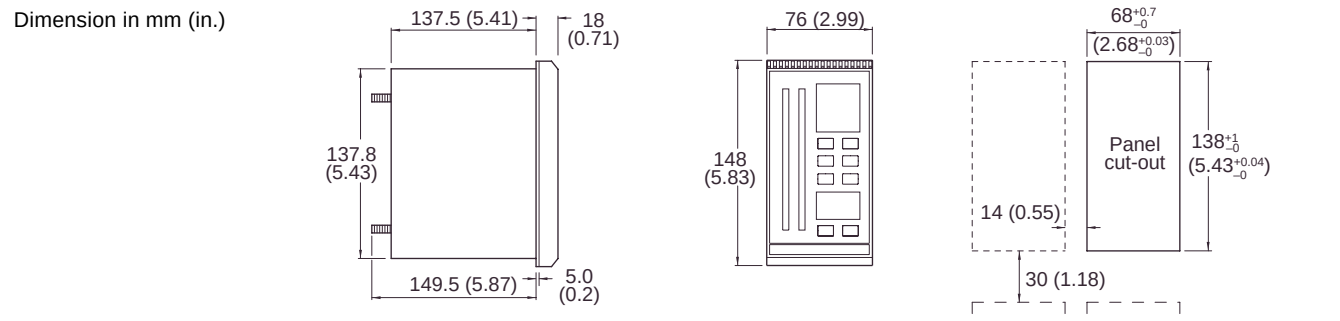
Front face

NEMA4X (IP66)

Electrical Connections



Overall Dimensions

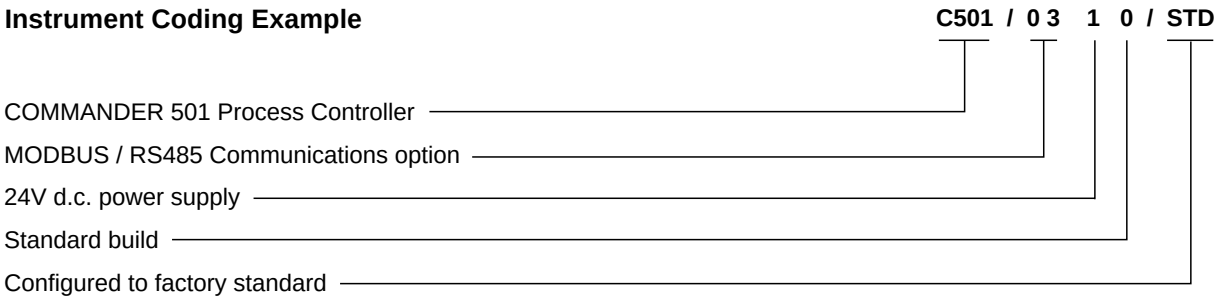


Ordering Guide

COMMANDER 501 Process Controller		**C501**	**/**	**X**	**X**	**X**	**/**	**X**	**X**	**X**	**X**
Option Board	None		0	0							
	2 x Digital Input 2 x Relay		0	1							
	1 x Analog Input 1 x Analog Output 2 x Digital Inputs 2 x Relay		0	2*							
	RS485 MODBUS		0	3							
	1 x Analog Input 1 x Analog Output 2 x Digital Inputs 2 x Relays RS485 MODBUS		0	4*							
Power Supply	85V to 265V a.c.				0						
	24V d.c.				1						
Build	Standard					0					
	CSA approval (pending)					1					
	UL approval (pending)					2					
Programming/Special Features	Configured to factory standard							S	T	D	
	Configured to customer detail							C	U	S	
	Agreed special features							S	P	X	X

***** If configuring a COMMANDER 501 for motorized valve control with feedback, or dual analog output on heat/cool, either option 02 or 04 must be fitted.

Instrument Coding Example



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