

Servo Motor Control Modes

- Cyclic Synchronous Position-Velocity-Torque (CSP, CSV, CST)
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position, Velocity, Torque

Stepper Motor Control Modes

- Cyclic Synchronous Position (CSP)
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Position/Velocity/Torque (Servo Mode)
- Position (Microstepping)
- Indexer, Point-to-Point, PVT
- Camming, Gearing

Command Interface

- CANopen application protocol over EtherCAT (CoE)
- ASCII and discrete I/O
- Stepper commands
- $\pm 10V$ position/velocity/torque
- PWM velocity/torque command
- Master encoder (Gearing/Camming)

Communications

- EtherCAT
- RS-232

Feedback

- Digital quad A/B/X encoder
- Absolute encoders
- Sin/Cos encoder
- Digital Halls

I/O Digital

- 19 HS inputs
- 3 MOSFET outputs
- 6 CMOS HS outputs

I/O Analog

- 3 $\pm 10V$ inputs

I/O SLI

- 1 HS input
- 3 CMOS HS outputs

Dimensions: mm [in]

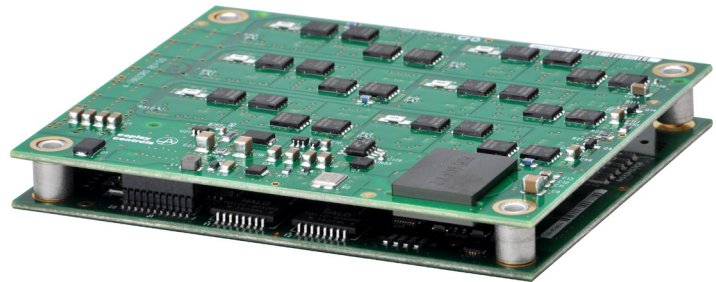
- 101.6 x 85.1 x 21 [4.0 x 3.35 x 0.83]

DESCRIPTION

The ME3 is a 3-axis, high-performance, DC powered drive for position, velocity, and torque control of servo and stepper motors via EtherCAT. Using advanced FPGA technology, the ME3 provides a significant reduction in the cost per node in multi-axis EtherCAT systems.

Each of the three axes in the ME3 operate as EtherCAT axes under DSP-402 for motion control devices. Supported modes include: Cyclic Synchronous Position/Velocity/Torque, Profile Position-Velocity, Interpolated Position Mode (PVT), and Homing.

Servo mode of steppers allows EtherCAT or digital PWM control of position/velocity/torque. In microstepping mode stepper command pulses and master encoder for camming or gearing is supported.



Model	Ic	Ip	Vdc
ME3-090-10	5	10	14~90

Nineteen high-speed digital inputs with programmable functions are provided. There are six CMOS high-speed outputs. Three MOSFET outputs that are 24V compatible can power motor brakes.

An SLI port is provided with one high-speed input and three high-speed digital outputs. If not used for SLI, the input and outputs are programmable for other functions.

An RS-232 serial port provides a connection to Copley's CME software for commissioning, firmware upgrading, and saving configurations to flash memory. The EtherCAT port is optically isolated.

Drive power is transformer-isolated DC from regulated or unregulated power supplies. An AuxHV input is provided for "keep-alive" operation permitting the drive power stage to be completely powered down without losing position information, or communications with the control system.

GENERAL SPECIFICATIONS

Test conditions: Load = Bipolar stepper: 2 mH + 2 Ω per phase. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	ME3-090-10	
OUTPUT POWER (each axis)		
Peak Current	10 (7.07)	Adc (Arms-sine), ±5%
Peak time	1	Sec
Continuous current	5 (3.53)	Adc (Arms-sine) per phase (Note 1)
Maximum Output Voltage	Vout = HV*0.97 - Rout*Iout	
INPUT POWER (module)		
HVmin~HVmax	+14 to +90	Vdc Transformer-isolated
Ipeak	30	Adc (1 sec) peak
Icont	5	Adc continuous (Note 1)
Aux HV	24 Vdc typ , 12.3 W max with all encoders @ 500 mA, 2.6 W max with no encoders	
PWM OUTPUTS		
Type	Dual H-bridge MOSFET , 12.5 kHz center-weighted PWM, space-vector modulation	
PWM ripple frequency	25 kHz	
CONTROL MODES SERVO MOTORS		
EtherCAT: CAN application protocol over EtherCAT (CoE): Cyclic Synchronous Position/Velocity/Torque, Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity/torque, 12-bit resolution		
Digital PWM velocity/torque		
Digital position: CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: camming, internal indexer and function generator		
CONTROL MODES STEPPER MOTORS		
EtherCAT: CAN application protocol over EtherCAT (CoE): Cyclic Synchronous Position/Velocity (Torque in servo mode) Profile Position/Velocity (Torque in servo mode), Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity/torque, 12-bit resolution		
Digital PWM velocity (Torque in servo mode)		
Digital stepper position commands, CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: camming, internal indexer and function generator		
COMMAND INPUTS		
Type	EtherCAT, galvanically isolated from drive circuits	
Signals & format	TX+, TX-, RX+, RX-; 100BaseTX	
Data protocol	CAN application protocol over EtherCAT (CoE)	
Device ID Selection	Programmable, or via digital inputs	
Analog	±10 Vdc, torque/velocity control (see above)	
Digital	High speed inputs for PWM velocity/torque and stepper/encoder position commands (see above)	
Camming	Quad A/B digital encoder	
DIGITAL CONTROL		
Digital Control Loops	Current, velocity, position. 100% digital loop control	
Sampling rate (time)	Current loop: 12.5 kHz (80 μs), Velocity & position loops: 2.5 kHz (400 μs) See Note 2.	
Commutation	Sinusoidal, field-oriented control for servo motors or stepper motors in servo mode	
Modulation	Center-weighted PWM with space-vector modulation	
Bandwidths	Current loop: 2.5 kHz typical, bandwidth will vary with tuning & load inductance	
HV Compensation	Changes in bus voltage do not affect bandwidth	
Minimum load inductance	200 μH line-line	
ANALOG INPUTS		
Number	3	
Type	±10 Vdc, 12-bit resolution, differential	
DIGITAL INPUTS		
Number, type	19, 74LVC14 Schmitt trigger, Vcc = 3.3 Vdc, V _{T+} = 1.1~2 Vdc, V _{T-} = 0.8~1.5 Vdc, V _{H+} = 0.3~1.2 Vdc	
[IN1~18]	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, 7V tolerant	
[IN19]	SLI port MISO input, 47 ns RC filter, 10 kΩ pull-up to +5 Vdc, 7V tolerant	
Halls	9, 74HC14 Schmitt trigger, Vcc = 5 Vdc, V _{T+} = 2.5~3.5 Vdc, V _{T-} = 1.3~2.2 Vdc, V _{H+} = ±0.7~1.5 Vdc	
	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, 24V tolerant	
Functions	Default functions are shown above, programmable to other functions	
DIGITAL OUTPUTS		
Number	9	
[OUT1~3]	Open-drain MOSFET with 1 kΩ pull-up with series diode to +5 Vdc 300 mAdc max, +30 Vdc max. Functions programmable External flyback diodes required for driving inductive loads	
[OUT4~9]	SLI port MOSI, SCLK, SS1 signals, 74AHCT240 line drivers; +5 Vdc tolerant; Output current: -8 mA source @ V _{OH} = 2.4V, 6 mA sink at V _{OL} = 0.5V	
Functions	Default functions are shown above, programmable to other functions	
DC POWER OUTPUT		
Number	3	
Ratings	+5 Vdc, 500 mA max each output, thermal and short-circuit protected	
RS-232 PORT		
Signals	RxD, TxD, Gnd for operation as a DTE device	
Mode	Full-duplex, DTE serial port for drive setup and control, 9,600 to 115,200 Baud Baud rate defaults to 9,600 after power-on or reset. Programmable to 19,200, 57,600, 115,200	
Protocol	ASCII or Binary format	

Notes:

- 1) Forced-air cooling may be required for operation at full output power on all axes.
- 2) Default settings for current and position loop frequencies. User programmable for other frequencies.

GENERAL SPECIFICATIONS

FEEDBACK (each axis)

Incremental:

Digital Incremental Encoder Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required)
 5 MHz maximum line frequency (20 M counts/sec)
 MAX14891 differential line receiver with fault detection for A, B, X inputs

Analog Incremental Encoder Sin/Cos format (sin+, sin-, cos+, cos-), differential, 1 V_{peak-peak},
 Digital Index (X, /X) input

Absolute:

SSI Clock (X, /X), Data (A, /A) signals
 EnDat Clock (X, /X), Data (A, /A)
 Absolute A Tamagawa Absolute A, Panasonic Absolute A Format, Sanyo Denki Absolute A
 SD+, SD- (A, /A) signals, 2.5 or 4 MHz, 2-wire half-duplex communication
 Status data for encoder operating conditions and errors

BiSS (B&C) MA+, MA- (X, /X), SL+, SL- (A, /A) signals, 4-wire, clock output from ME3, data returned from encoder

Secondary:

3 MAX3362 differential line receiver/transmitters, programmable as incremental encoder A/B/X,
 or absolute full-duplex X (clock) and A (data), or absolute half-duplex A (clock/data)
 9 74HC14 Schmitt trigger, V_{cc} = 5.0V, V_{T+} = 1.8~3.5 Vdc, V_{T-} = 1.0~2.2 Vdc, V_{H+} = 0.47~1.47 Vdc

Halls

MOTOR CONNECTIONS (each axis)

Phase U, V, W PWM outputs to 3-phase ungrounded Wye or delta connected brushless motors, or DC brush motors
 Phase A, /A, B, /B Dual PWM H-bridge outputs for each axis to drive stepper motors with bipolar windings
 Output functions are individually programmable to drive servo or stepper motors

Encoders See FEEDBACK section above
 Hall & encoder power See DC POWER OUTPUTS section

PROTECTIONS

HV Overvoltage +HV > 90 Vdc Drive outputs turn off until +HV < 90 Vdc
 HV Undervoltage +HV < +14 Vdc Drive outputs turn off until +HV > +14 Vdc
 Drive over temperature Heat plate > 70°C. Drive outputs turn off
 Short circuits Output to output, output to ground, internal PWM bridge faults
 I²T Current limiting Programmable: continuous current, peak current, peak time
 Motor over temperature Digital inputs programmable to detect motor temperature switch
 Feedback Loss Inadequate analog encoder amplitude or missing incremental encoder signals

MECHANICAL & ENVIRONMENTAL

Size mm [in] 101.6 x 85.1 x 21 [4.0 x 3.35 x 0.83]
 Weight ME3: 0.09 kg [0.20 lb], ME3 + DevKit: 0.38 kg [0.84 lb]
 Ambient temperature 0 to +45°C operating, -40 to +85°C storage
 Humidity 0 to 95%, non-condensing
 Vibration 2 g peak, 10~500 Hz (sine), IEC60068-2-6
 Shock 10 g, 10 ms, half-sine pulse, IEC60068-2-27
 Contaminants Pollution degree 2
 Environment IEC68-2: 1990
 Cooling Heat sink and/or forced air cooling required for continuous power output

AGENCY STANDARDS CONFORMANCE

In accordance with EC Directive 2014/30/EU (EMC Directive)

EN 55011: 2009/A1:2010 CISPR 11:2009/A1:2010
 Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment –
 Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement
 Group 1, Class A

EN 61000-6-1: 2007 Electromagnetic Compatibility (EMC) – Part 6-1: Generic Standards –
 Immunity for residential, Commercial and Light-industrial Environments

In accordance with EC Directive 2014/35/EU (Low Voltage Directive)

IEC 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

Underwriters Laboratory Standards

UL 61010-1, 3rd Ed.: 2012-05 Electrical Equipment for Measurement, Control and Laboratory Use;
 Part 1: General Requirements

UL File Number E168959

Restriction of the Use of Certain Hazardous Substances (RoHS)

Directive 2011/65/EU (RoHS II) and its amendments EU Directive 2015/863



RoHS Directive 2011/65/EU is now part of the CE marking procedure

3-AXIS DIGITAL DRIVE FOR SERVO & STEPPER MOTORS

Servo Control Modes

- Profile Position-Velocity, Interpolated Position, Homing
- Indexer, Point-to-Point, PVT
- Camming, Gearing
- Position/Velocity/Torque

Stepper Control Modes

- Cyclic Synchronous Position (CSP)
- Profile Position-Velocity-Torque, Interpolated Position, Homing
- Position (Microstepping)
- Position/Velocity/Torque (Servo Mode)
- Indexer, Point-to-Point, PVT
- Camming, Gearing

Command Interface

- CANopen
- ASCII and discrete I/O
- Stepper commands
- $\pm 10V$ or PWM velocity/torque (servo mode)
- Master encoder (Gearing/Camming)

Communications

- CANopen
- RS-232

Feedback

- Digital quad A/B/X encoder
- Absolute encoders
- Sin/Cos encoders
- Digital Halls

I/O Digital

- 19 HS inputs
- 3 MOSFET outputs
- 6 CMOS HS outputs

I/O Analog

- 3 $\pm 10V$ inputs

I/O SLI

- 1 HS input
- 3 CMOS HS outputs

Dimensions: mm [in]

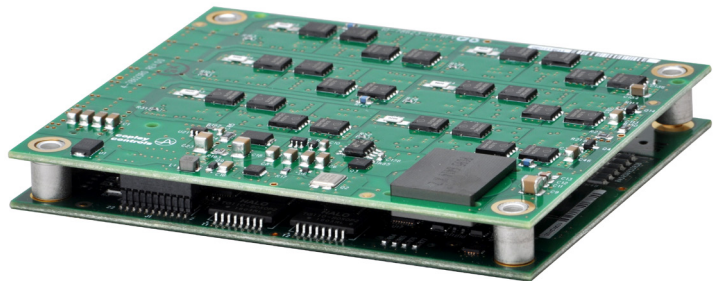
- 101.6 x 85.1 x 21 [4.0 x 3.35 x 0.83]

DESCRIPTION

The MP3 is a 3-axis, high-performance, DC powered drive for position, velocity, and torque control of stepper and motors via CANopen. Using advanced FPGA technology, the MP3 provides a significant reduction in the cost per node in multi-axis CANopen systems.

Each of the three axes in the MP3 operate as CANopen nodes under CiA-402 for motion control devices. Supported modes include: Profile Position-Velocity, Interpolated Position Mode (PVT), and Homing.

Servo mode of steppers allows CANopen or digital PWM control of position/velocity/torque. In microstepping mode stepper command pulses and master encoder for camming or gearing is supported.



Model	Ic	Ip	Vdc
MP3-090-10	5	10	14~90

Nineteen high-speed digital inputs with programmable functions are provided. There are six CMOS high-speed outputs. Three MOSFET outputs that are 24V compatible can power motor brakes.

An SLI port is provided with one high-speed input and three high-speed digital outputs. If not used for SLI, the input and outputs are programmable for other functions.

An RS-232 serial port provides a connection to Copley's CME software for commissioning, firmware upgrading, and saving configurations to flash memory. The CANopen port is optically isolated.

Drive power is transformer-isolated DC from regulated or unregulated power supplies. An AuxHV input is provided for "keep-alive" operation permitting the drive power stage to be completely powered down without losing position information, or communications with the control system.

GENERAL SPECIFICATIONS

Test conditions: Load = Bipolar stepper: 2 mH + 2 Ω per phase. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	MP3-090-10	
OUTPUT POWER (each axis)		
Peak Current	10 (7.07)	Adc (Arms-sine), ±5%
Peak time	1	Sec
Continuous current	5 (3.53)	Adc (Arms-sine) per phase (Note 1)
Maximum Output Voltage	Vout = HV*0.97 - Rout*Iout	
INPUT POWER (module)		
HVmin~HVmax	+14 to +90	Vdc Transformer-isolated
Ipeak	30	Adc (1 sec) peak
Icont	15	Adc continuous (Note 1)
Aux HV	24 Vdc typ , 12.3 W max with all encoders @ 500 mA, 2.6 W max with no encoders	
PWM OUTPUTS		
Type	Dual H-bridge MOSFET , 12.5 kHz center-weighted PWM, space-vector modulation	
PWM ripple frequency	25 kHz	
CONTROL MODES SERVO		
CANopen: Profile Position/Velocity/Torque, Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity/torque, 12-bit resolution		
Digital PWM velocity/torque		
Digital position: CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: Camming, internal indexer and function generator		
CONTROL MODES STEPPER		
CANopen: Profile Position/Velocity (/Torque in servo mode), Interpolated Position (PVT), Homing		
Analog ±10 Vdc velocity (/Torque in servo mode), 12-bit resolution		
Digital PWM velocity (/Torque in servo mode)		
Digital stepper position commands, CW/CCW, Pulse/Direction, Quadrature A/B		
Discrete I/O: Camming, internal indexer and function generator		
COMMAND INPUTS		
Type	CANopen, galvanically isolated from drive circuits	
Signals & format	CAN_H, CAN_L, CAN_GND	
Device ID Selection	Programmable, or via digital inputs	
Analog	±10 Vdc, torque/velocity control, 12-bit resolution	
Digital	High speed inputs for PWM velocity/torque and stepper/encoder position commands	
Camming	Quad A/B digital encoder	
DIGITAL CONTROL		
Digital Control Loops	Current, velocity, position. 100% digital loop control	
Sampling rate (time)	Current loop: 12.5 kHz (80 μs), Velocity & position loops: 2.5 kHz (400 μs) See note 2.	
Commutation	Sinusoidal, field-oriented control for stepper motors	
Modulation	Center-weighted PWM with space-vector modulation	
Bandwidths	Current loop: 2.5 kHz typical, bandwidth will vary with tuning & load inductance	
HV Compensation	Changes in bus voltage do not affect bandwidth	
Minimum load inductance	200 μH line-line	
ANALOG INPUTS		
Number	3	
Type	±10 Vdc, 12-bit resolution, differential	
DIGITAL INPUTS		
Number, type	19, 74LVC14 Schmitt trigger, Vcc = 3.3 Vdc, + = 1.1~2 Vdc, V _{T-} = 0.8~1.5 Vdc, V _{H+} = 0.3~1.2 Vdc	
[IN1~18]	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +3.3 Vdc, 7V tolerant	
[IN19]	SLI port MISO input, 47 ns RC filter, 10 kΩ pull-up to +3.3 Vdc, 7V tolerant	
Halls	9, 74HC14 Schmitt trigger, V _{T+} = 2.5~3.5 Vdc, V _{T-} = 1.3~2.2 Vdc, V _{H+} = ±0.7~1.5 Vdc	
Functions	High-speed (HS) digital, 100 ns RC filter, 10 kΩ pull-up to +5 Vdc, 24V tolerant	
Functions	Default functions are shown above, programmable to other functions	
DIGITAL OUTPUTS		
Number	9	
[OUT1~3]	Open-drain MOSFET with 1 kΩ pull-up with series diode to +5 Vdc	
	300 mAdc max, +30 Vdc max. Functions programmable	
	External flyback diodes required for driving inductive loads	
[OUT4~9]	SLI port MOSI, SCLK, SS1 signals, 74AHCT240 line drivers; +5 Vdc tolerant;	
	Output current:-8 mA source @ V _{OH} = 2.4V, 6 mA sink at V _{OL} = 0.5V	
Functions	Default functions are shown above, programmable to other functions	
DC POWER OUTPUT		
Number	3	
Ratings	+5 Vdc, 500 mA max each output, thermal and short-circuit protected	
RS-232 PORT		
Signals	Rx/D, Tx/D, Gnd for operation as a DTE device	
Mode	Full-duplex, DTE serial port for drive setup and control, 9,600 to 115,200 Baud	
	Baud rate defaults to 9,600 after power-on or reset. Programmable to 19,200, 57,600, 115,200	
Protocol	ASCII or Binary format	

Notes:

- 1) Forced-air cooling may be required for operation at full output power on all axes.
- 2) Default settings for current and position loop frequencies. User programmable for other frequencies.

GENERAL SPECIFICATIONS

FEEDBACK (each axis)

Incremental:

Digital Incremental Encoder Quadrature signals, (A, /A, B, /B, X, /X), differential (X, /X Index signals not required)
5 MHz maximum line frequency (20 M counts/sec)
MAX14891 differential line receiver with fault detection for A, B, X inputs

Analog Incremental Encoder Sin/Cos format (sin+, sin-, cos+, cos-), differential, 1 Vpeak-peak,
Digital Index (X, /X) input

Absolute:

SSI Clock (X, /X), Data (A, /A) signals
EnDat Clock (X, /X), Data (A, /A) signals
Absolute A Tamagawa Absolute A, Panasonic Absolute A Format, Sanyo Denki Absolute A
SD+, SD- (A, /A) signals, 2.5 or 4 MHz, 2-wire half-duplex communication
Status data for encoder operating conditions and errors

BiSS (B&C) MA+, MA- (X, /X), SL+, SL- (A, /A) signals, 4-wire, clock output from MP3, data returned from encoder

Secondary:

3 MAX3362 differential line receiver/transmitters, programmable as incremental encoder A/B/X,
or absolute full-duplex X (clock) and A (data), or half-duplex A (clock/data)
9 74HC14 Schmitt trigger, Vcc = 5.0V, V_{T+} = 1.8~3.5 Vdc, V_{T-} = 1.0~2.2 Vdc, V_{IL+} = 0.47~1.47 Vdc

Halls

MOTOR CONNECTIONS (each axis)

Phase U, V, W PWM outputs to 3-phase ungrounded Wye or delta connected brushless motors, or DC brush motors
Phase A, /A, B, /B Dual PWM H-bridge outputs for each axis to drive stepper motors with bipolar windings
Output functions are individually programmable to drive servo or stepper motors

Encoders See FEEDBACK section above
Hall & encoder power See DC POWER OUTPUTS section

PROTECTIONS

HV Overvoltage +HV > 90 Vdc Drive outputs turn off until +HV < 90 Vdc
HV Undervoltage +HV < +14 Vdc Drive outputs turn off until +HV > +14 Vdc
Drive over temperature Heat plate > 70°C. Drive outputs turn off
Short circuits Output to output, output to ground, internal PWM bridge faults
I²T Current limiting Programmable: continuous current, peak current, peak time
Motor over temperature Digital inputs programmable to detect motor temperature switch
Feedback Loss Inadequate analog encoder amplitude or missing incremental encoder signals

MECHANICAL & ENVIRONMENTAL

Size mm [in] 101.6 x 85.1 x 21 [4.0 x 3.35 x 0.83]
Weight MP3: 0.09 kg [0.20 lb], MP3 + DevKit: 0.38 kg [0.84 lb]
Ambient temperature 0 to +45°C operating, -40 to +85°C storage
Humidity 0 to 95%, non-condensing
Vibration 2 g peak, 10~500 Hz (sine), IEC60068-2-6
Shock 10 g, 10 ms, half-sine pulse, IEC60068-2-27
Contaminants Pollution degree 2
Environment IEC68-2
Cooling Forced air cooling may be required for continuous power output

AGENCY STANDARDS CONFORMANCE

In accordance with EC Directive 2014/30/EU (EMC Directive)

EN 55011 CISPR 11
Industrial, Scientific, and Medical (ISM) Radio Frequency Equipment –
Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement
Group 1, Class A

EN 61000-6-1 Electromagnetic Compatibility (EMC) – Part 6-1: Generic Standards –
Immunity for residential, Commercial and Light-industrial Environments

In accordance with EC Directive 2014/35/EU (Low Voltage Directive)

IEC 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

Underwriters Laboratory Standards

UL 61010-1, 3rd Ed Electrical Equipment for Measurement, Control and Laboratory Use;
Part 1: General Requirements

UL File Number E168959

Restriction of the Use of Certain Hazardous Substances (RoHS)

Directive 2011/65/EU (RoHS II) and its amendments EU Directive 2015/863



RoHS Directive 2011/65/EU is now part of the CE marking procedure