

# **Tambourine 30 Power Supply Installation Guide**



## Notice

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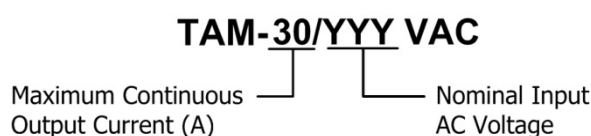
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## Catalog Number



## Revision History

Version	Date	Details
Ver. 1.000	April 2014	Initial release
Ver. 1.001	June 2014	Document update
Ver. 1.100	Aug 2014	Drawing changes and addition of Over Voltage Protection
Ver. 1.200	Aug 2019	Update the safety measures in the "Enable Bypass" Connector Feature section



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## ***Chapter 1: Operating Safely***

In order to operate the Tambourine 30 power supply safely, it is imperative that you implement the safety procedures included in this installation guide. This information is provided to protect you and to keep your work area safe when using the Power Supply.

**Please read this chapter carefully, before you begin the installation process.**

Before you start, make sure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth connection.

Only qualified personnel may install, adjust, maintain and repair the product. A qualified person has the knowledge and authorization to perform tasks such as transporting, assembling, installing, commissioning and operating power-supplies, drives and motors.

The Tambourine 30 power supply contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

To avoid any potential hazards that may cause severe personal injury or damage to the product during operation, keep all covers and cabinet doors shut.

The following safety symbols are used in this manual:



**Warning:**

This information is needed to avoid a safety hazard, which might cause bodily injury.



**Caution:**

This information is necessary for preventing damage to the product or to other equipment.



## 1.1. Warnings

- To avoid electric arcing and hazards to personnel and electrical contacts, never connect/disconnect the Tambourine 30 power supply while the power source is on.
- Disconnect the Tambourine 30 power supply from all voltage sources before it is opened for servicing.
- The Tambourine 30 power supply contains grounding conduits for electric current protection. Any disruption to these conduits may cause the instrument to become hot (live) and dangerous.
- After shutting off the power and removing the power source from your equipment, wait as described in the tables below, before touching or disconnecting parts of the equipment that are normally loaded with electrical charges (such as capacitors or contacts). It is recommended to measure the electrical contact points with a DVM before touching the equipment.

T.P #	Function	Ref.	Results
1	Discharge time with no load	VP+, VN-	2 min 30 sec
2	Discharge time while the Tambourine 30 is connected to Elmo drive at MO=0	VP+, VN-	2 min
3	Discharge time with maximum load up to 30 A	VP+, VN-	20 msec

Table 1: 480 VAC



## 1.2. Cautions

- The Tambourine 30 power supply contains hot surfaces and electrically charged components during operation.
- The maximum AC/DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- Before switching on the Tambourine 30 power supply, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.

## 1.3. Directives and Standards

The Tambourine 30 power supply conforms to the following industry safety standards:

Safety Standard	Item
In compliance with <b>UL 61800-5-1</b>	Safety for adjustable speed electrical power drive system
In compliance with <b>UL 508C</b>	Power Conversion Equipment
In compliance with <b>UL 840</b>	Insulation Coordination, Including Clearance and Creepage Distances of Electrical Equipment
In compliance with <b>UL 60950-1</b> (formerly <b>UL 1950</b> )	Safety of Information Technology Equipment, Including Electrical Business Equipment
In compliance with <b>EN 60204-1</b>	Low Voltage Directive, 73/23/EEC



The Tambourine 30 power supply has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

## 1.4. CE Mark Conformance

The Tambourine 30 power supply is intended for incorporation in a machine or end product. The actual end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 98/37/EC as amended, and with those of the most recent versions of standards **EN 60204-1** and **EN 292-2** at the least.

According to Annex III of Article 13 of Council Directive 93/68/EEC, amending Council Directive 73/23/EEC concerning electrical equipment designed for use within certain voltage limits, the Tambourine 30 power supply meets the provisions outlined in Council Directive 73/23/EEC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

## 1.5. Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the time of installation, or 18 months from time of shipment, whichever comes first. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.



## Chapter 2: Product Description



The Tambourine 30 power supply is a compact direct-to-mains power supply designed to power multiple servo drives up to 528 VAC. It was designed to complement Elmo servo drives that do not include an integrated power supply. It has the following features:

- Rectifies AC input voltages of up to 3×528 VAC into filtered DC voltage with an output current of 30 A continuous and a 60 A peak.
- The number of servo drives powered by a single Tambourine 30 power supply is limited only by the total power consumption of the servo drives and not by the output current of the Tambourine 30.
- Can operate directly from the mains when feeding isolated servo drives, or via an isolation transformer when non- isolated servo drives are employed.
- Has a high capacitance to offer a low output voltage drop while operating from a single-phase source.
- Has regenerating braking capability that enables fast braking of high inertia.
- Has built-in active zero crossing inrush current limiters that limit the power-on currents to low levels, reducing turn-on stress from the mains.
- Has internal EMC filtering that eliminates the necessity for external devices, therefore complies with CE and other EMC regulations.
- Has a Book Shelf (Panel Mount) structure, enabling simple and fast mounting.





## 2.1. Standard Features

- 30 A continuous output current
- AC input 20 to 500 Hz
- Single- or three-phase operation
- Direct-to-mains operation capability
- High regenerative (braking) capability
- Active zero crossing inrush current limit
- EMC filtering “inside”
- UL, CE, compliant

## 2.2. Duty Cycle Protection

The Tambourine 30 power supply includes a duty cycle limiter, which inhibits shunt whenever On and Off time exceeds 2%. This feature protects the shunt regulator when high-inertia loads are driven by the servo drive(s) or when too high AC voltage is applied to the power supply (i.e., DC output is already above the threshold of the shunt).

### 2.2.1. Shunt Regulator

A shunt regulator is included in the power supply section of the Tambourine 30. The shunt regulator is a switching type, wherein dissipative elements (power resistors) are switched across the DC bus, whenever the voltage reaches a predetermined level. The function of the shunt regulator is to regulate the voltage of the DC bus during the period of motor deceleration, when there is a net energy outflow from the motor to the servo drive, to prevent the servo drive from disabling itself as a result of an “over-voltage” type reason.

When the capacitors charge-up reaches the predetermined shunt threshold level, the shunt regulator begins its regulating action. The bus is regulated to the specific model type voltage, until the regeneration-energy is dissipated.

When the capacitors charge-up reaches the predetermined shunt threshold level, the shunt regulator begins its regulating action. The bus is regulated to the specific model type voltage, until regeneration ceases.

## 2.3. Over Voltage Protection

The Tambourine 30 power supply has been fitted with an over-voltage protection mechanism, providing protection from very high AC input voltage than defined by the hardware. Whenever a very high voltage input occurs, the over-voltage protection mechanism shuts down the bridge rectifier and output voltage.



## 2.4. Technical Specifications

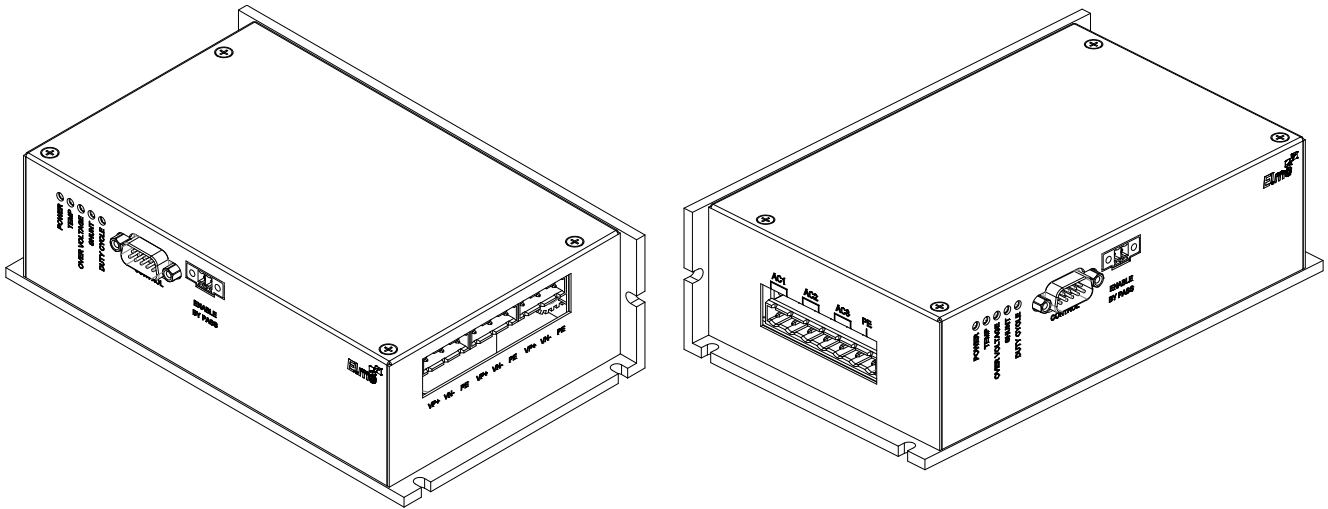
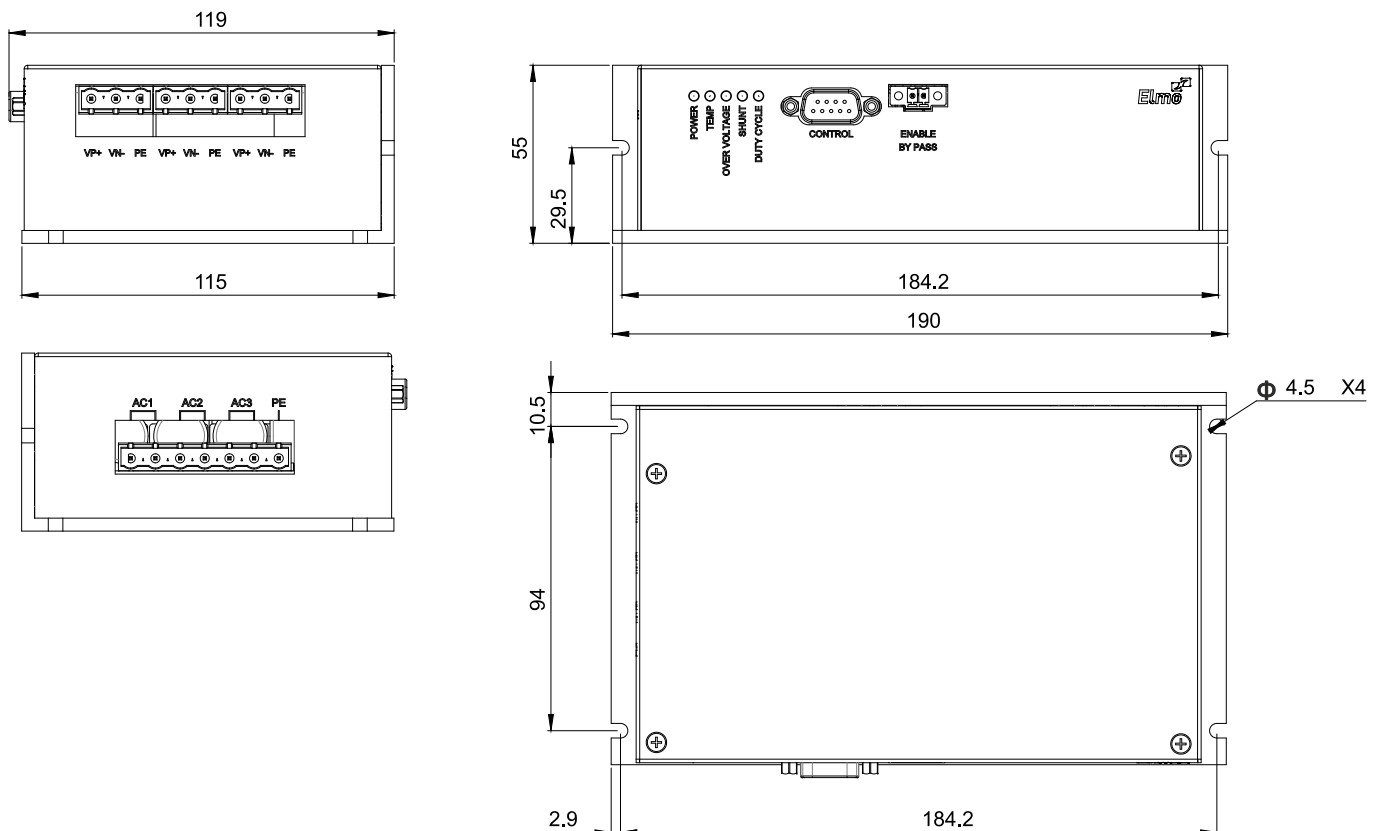


Figure 1: Tambourine 30 Power Supply

### 2.4.1. Dimensions

#### 2.4.1.1. Housing of the 36 VAC up to 480 VAC Models





## 2.4.2. Electrical and Mechanical Specifications

Power Supply	TAM-30/ 36 VAC	TAM-30/ 60 VAC	TAM-30/ 120 VAC	TAM-30/ 230 VAC	TAM-30/ 420 VAC	TAM -30/ 480 VAC
Nominal Input AC Voltage	1×36 VAC 3×36 VAC	1×60 VAC 3×60 VAC	1×120 VAC 3×120 VAC	1×230 VAC 3×230 VAC	3×420 VAC	3×480 VAC
Max Input AC Voltage	1×38 VAC (L-N) 3×38 VAC (L-L)	1×61 VAC (L-N) 3×61 VAC (L-L)	1×131 VAC (L-N) 3×131 VAC (L-L)	1×270 VAC (L-N) 3×270 VAC (L-L)	3×470 VAC (L-L)	3×528 VAC (L-L)
Max Output Power Cont.	1650 W	2700 W	5700 W	11400 W	19500 W	21000 W
Max Output Power Peak	3300 W	5400 W	11400 W	22800 W	39000 W	42000 W
Nominal DC bus Output (at nominal AC Voltage)	50 VDC	85 VDC	170 VDC	325 VDC	560 VDC (for 400 VAC) 594 VDC (for 420 VAC)	560 VDC (for 400 VAC) 678 VDC (for 480 VAC)
Shunt Power (Peak)	1.8 kW	4.5 kW	5.5 kW	6 KW	5.5 kW	6.7 kW
DC Output Cont. Current	30 A	30 A	30 A	30 A	30 A	30 A
DC Output Peak Current	60 A	60 A	60 A	60 A	60 A	60 A
Mating Drives	XXX-YY/60	XXX-YY/100	XXX-YY/200	XXX-YY/400	XXX-YY/700	XXX-YY/800
Weight	1155 gr	1155 gr	1155 gr	1155 gr	1155 gr	1155 gr

**Table 2: Tambourine 30 Electrical Specifications**



## Chapter 3: Installation

This chapter describes the installation of the Tambourine 30 power supply.

### 3.1. Before You Begin

#### 3.1.1. Site Requirements

You can guarantee the safe operation of the Tambourine 30 by ensuring that it is installed in an appropriate environment.

Feature	Value
Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Maximum non-condensing humidity	90%
Models for extended environmental conditions are available.	



**Caution:** The Tambourine 30 dissipates its heat by convection. The maximum ambient operating temperature of 0 °C to 40 °C (32 °F to 104 °F) must not be exceeded.

#### 3.1.2. Hardware Requirements

##### 3.1.2.1. AC Input Requirements

Circuit Breakers & Contacts	Three-Phase Supply Voltage	Single-Phase Supply Voltage
Circuit breaker current rating	32 A Type C	40 A Type C
Circuit breaker voltage rating	250 VAC / 480 VAC depending upon operating AC voltage	
Contactor	32 A	40 A

##### 3.1.2.2. Recommended Wire Cross-Sections (All Models)

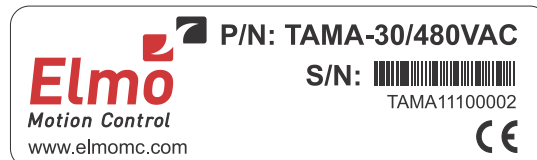
Feature	Connection	Details
AC input	AC1, AC2, AC3	2.08 mm <sup>2</sup> , 14 AWG
DC Output	VP+, VN-	2.08 mm <sup>2</sup> , 14 AWG
Protective Earth	PE	2.08 mm <sup>2</sup> , 14 AWG



## 3.2. Unpacking the Components

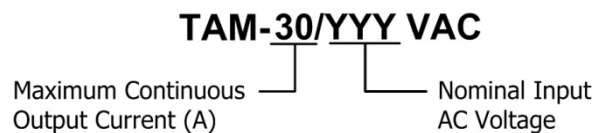
*To unpack the Tambourine 30:*

1. Carefully remove the power supply from the box and Styrofoam.
2. Check the product to ensure that there is no visible damage. If any damage has occurred, report immediately to the carrier that delivered your product.
3. To ensure that the Tambourine 30 you have unpacked is the appropriate type for your requirements, locate the part number sticker on the product.



TAMA009A

The Part number provides the type designation.



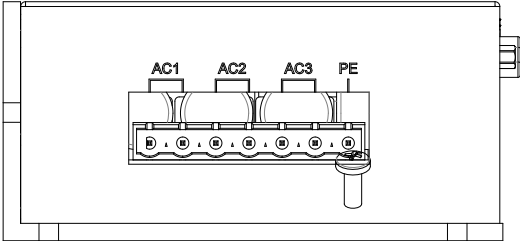
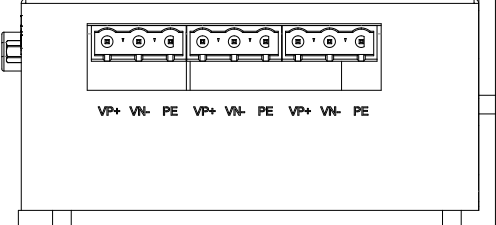
4. Verify that the Tambourine 30 model is the one you ordered, and ensure that the voltage meets your specific requirements.



### 3.3. Connectors

#### 3.3.1. Connector Types for 36 VAC up to 480 VAC Models

The Tambourine 30 is delivered with the following external mating connectors:

No. Pins	Type	Function
<b>Input Connector x1</b>		
 TAMA004A		
1 × 7 pins	Phoenix P/N 1714320 (GMSTB 2,5HCV/7-ST-7,62)	Main AC Input
<b>Output Connectors x4</b>		
 TAMA010A		
3 × 3 pins	Phoenix P/N 1714281 (GMSTB 2,5HCV/3-ST-7,62)	DC Outputs

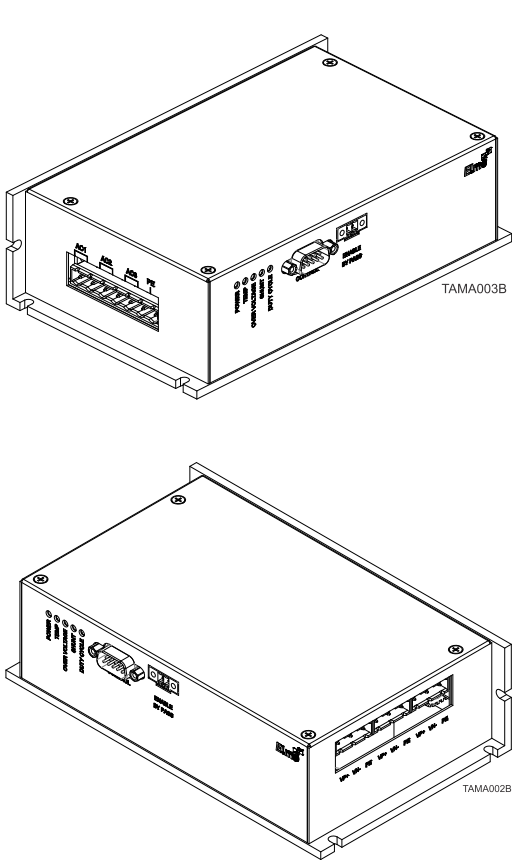


Table 3: Connector Types for 36 VAC up to 480 VAC Models



### 3.3.2. Main AC Input Power Connector Pinout

Refer to section 3.4.6 for details of the connections.

Pin	Signal	Function
AC1	AC Input phase #1	AC input
AC1	AC Input phase #1	AC input
AC2	AC Input phase #2	AC input
AC2	AC Input phase #2	AC input
AC3	AC Input phase #3	AC input
AC3	AC Input phase #3	AC input
PE	Protective Earth	AC input

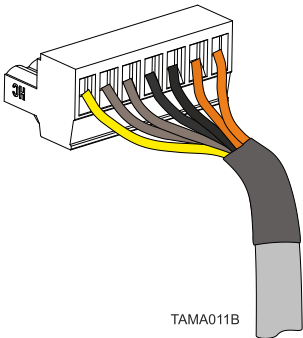
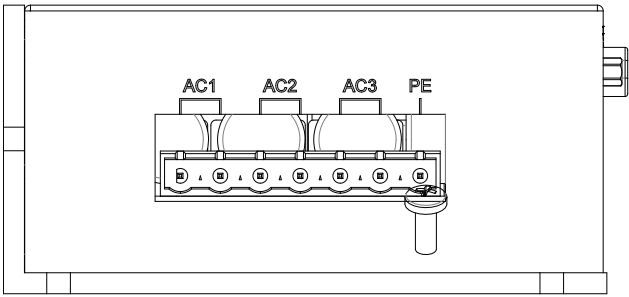


Table 4: Main AC Input Connector Pinout

### 3.3.3. 4x DC-Output Connector Pinout

Refer to section 3.4.7 for details of the connections.

Pin	Signal	Function
VP+	Positive Power output	DC output cable to a drive
VN-	Negative Power output	DC output cable to a drive
PE	Protective earth	DC output cable to a drive

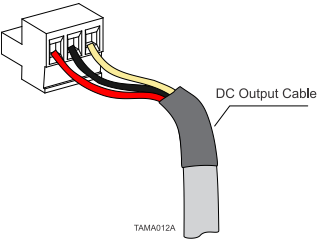
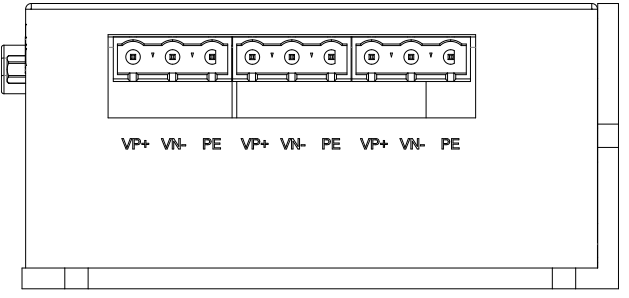
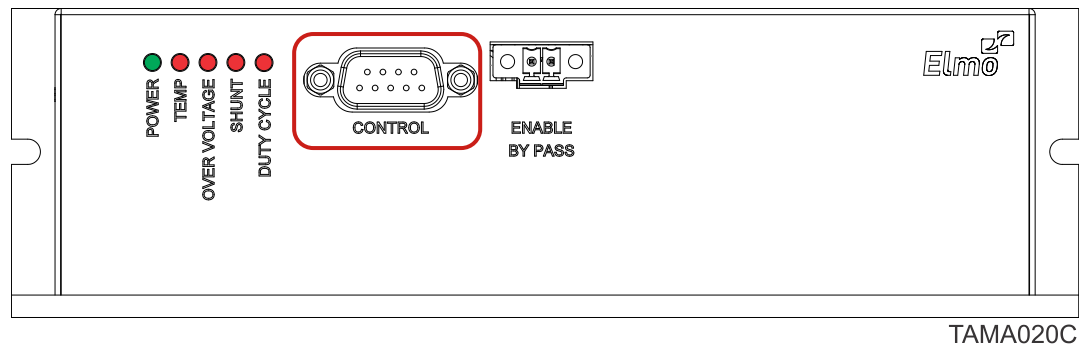


Table 5: DC- Output Connector to Drive Pinout



### 3.3.4. Control Connector Pinout

Pin	Signal	Function
1	"Power On" indication return	Opto emitter
2	"Power On" indication	Opto collector via resistor
3	ENABLE return	ENABLE NEGATIVE
4	ENABLE	ENABLE POSITIVE
5	N.C.	Not connected
6	N.C.	Not connected
7	N.C.	Not connected
8	AC Fault	Darlington opto collector output
9	AC Fault return	Darlington opto emitter output







### 3.3.4.1. AC Fault Detection

The Tambourine 30 is equipped with an internal "AC phase loss" detector. Whenever either one of the three AC input phases is interrupted, the detector's opto coupler output changes to the conductive state.

The pins 8 (collector) and 9 (emitter) at the "control" D-sub connector serve as the output terminals of this Opto Coupler. In order to externally utilize this output it is necessary to install a pull-up resistor to be connected between pin 8, and a voltage source (positive). Pin 9 should be connected to the negative voltage source.

Figure 2 shows the typical "fault-condition" output signals with a pull up resistor of 10 k $\Omega$  connected, along with a 24volt as the voltage source. It is recommended for the user to implement an additional processing stage at the detector's output.

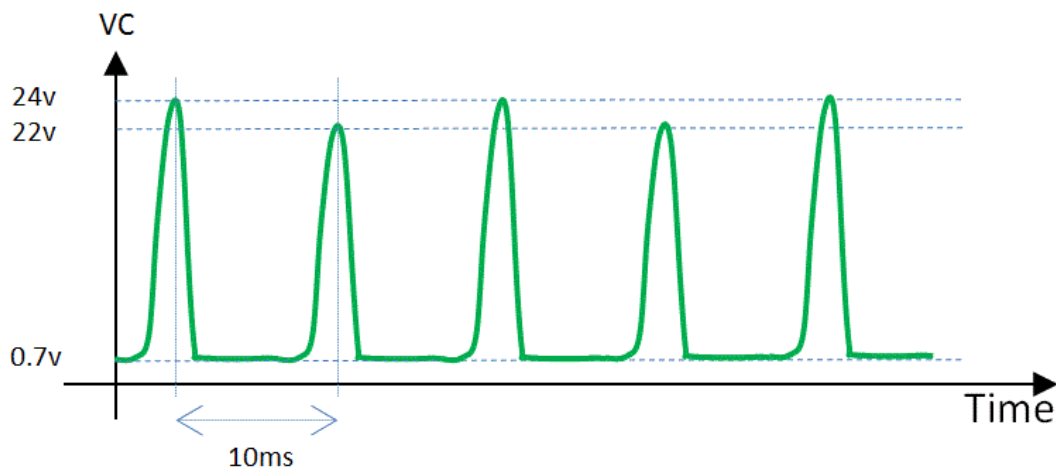


Figure 2: AC Fault Signal

#### 3.3.4.1.a AC Fault Output

Feature	Details
Type of output	Optically isolated Open collector and open emitter (Darlington)
Maximum Ext. supply range ( $V_{cc}$ )	30v
Max.output current $I_{out} (max) (V_{out}=Low)$	$I_{out} (max) \leq 10mA$
VOL at maximum output voltage (low level)	$V_{out} (on) \leq 1v$
RL	External resistor RL must be selected to limit output current to no more than 10 mA $RL = \frac{VCC - VOL}{Io(max)}$

IL755

ISO3

AC fault OC

AC fault Ret

D9M P2

VCC

R

PROCESSING STAGE

Normaly = ON  
At fault = OFF

CONTROL



### 3.3.5. “Enable” Feature

Whenever pins 3, 4 of the Control connector are active (**Enable**), and the Enable Bypass connector pins remain open, High DC voltage is output to the DC output connector.

The following table describes the electrical details of the Enable input.

Feature	Details
Type of input	Optically isolated
Input current for all inputs	$I_{in} = 2 \text{ mA} @ V_{in} = 12 \text{ V}$
High-level input voltage	$12 \text{ V} < V_{in} < 30 \text{ V}$
Low-level input voltage	$0 \text{ V} < V_{in} < 7 \text{ V}$

**Figure 3: Enable Input Schematic**



### 3.3.6. “Enable Bypass” Connector Feature



Do not implement the "Enable Bypass" Connector option described in this section before taking the following safety precautions:

- The required jumper is a high voltage wire, which, if exposed, and touched, can cause electrocution. Therefore, the jumper must have an isolating jacket over it.
- Do not manually plug or unplug this connector while there is still high voltage inside the product.

Following are the “Enable Bypass” connector pinouts.

Pin	Signal	Function
1	Enable Bypass 1	Shorting to Pin #2 bypasses the “Enable” function
2	Enable Bypass 2	Shorting to Pin #1 bypasses the “Enable” function

TAMA020C

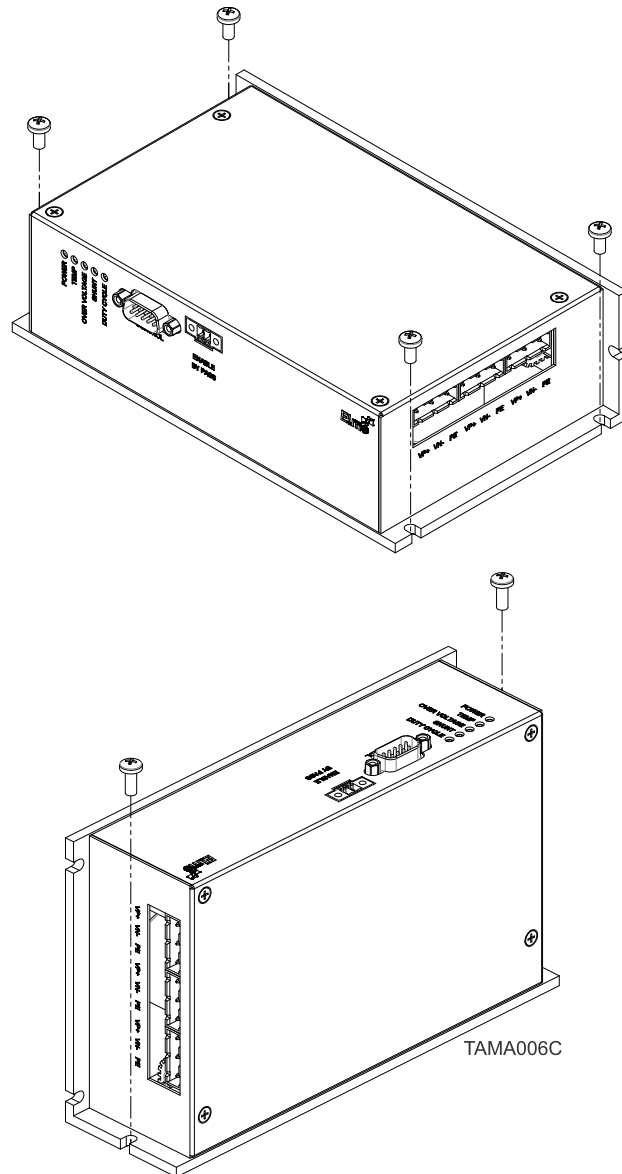
The Enable function in the Control connector can be ignored (if necessary) by connecting an isolated jumper between the two terminals of the “Enable Bypass” connector.



## 3.4. Mounting and Wiring the Tambourine 30

For optimum heat dissipation, the Tambourine 30 should be installed with the heat sink attached to the machine's chassis. When mounting the Tambourine 30 make sure to leave about 1 cm (0.4") outward from the heatsink, to enable free air convection around the power supply.

### 3.4.1. Mounting



**Figure 4: Mounting the Tambourine 30**

The Tambourine 30 is designed for two standard mounting options (Figure 3):

- Wall Mount along the back (can also be mounted horizontally on a metal surface)
  - Book Shelf along the side
1. Use M4 x 8 round head screws, one through each opening in the heat sink, to mount the Tambourine 30 in position opposite the specific holes drilled.
  2. Tighten the screws to just tight. Do not tighten the screws too much.



### 3.4.2. Wiring Guidelines

1. Use flexible wires with the proper cross-section to handle the unit current. Color coding is recommended.
2. After the wiring is completed, carefully inspect all connections in order to ensure tightness.

### 3.4.3. AC Power Source

The AC voltage supply can be of any voltage within the range defined in the Tambourine 30 technical specifications. It must be able to deliver power to the servo drives (including peak power), without significant drops. A three-phase supply is always recommended whenever possible, in order to provide better DC bus voltage stability (low voltage ripple) under high load conditions.

Inrush current control is included within the Tambourine 30 power supply, which makes the Tambourine 30 capable to be fed directly from the mains, whenever it supplies isolated drives.

When operating with a single-phase supply, a voltage drop due to loading is expected. The magnitude of the voltage drop depends on the load current and the stiffness of the power source. The following is a graph showing the typical expected VP+ drop, at certain load current when supplied by a single AC phase source:

### 3.4.4. Direct-to-Mains (Non Isolated Transformer) Wiring Diagrams

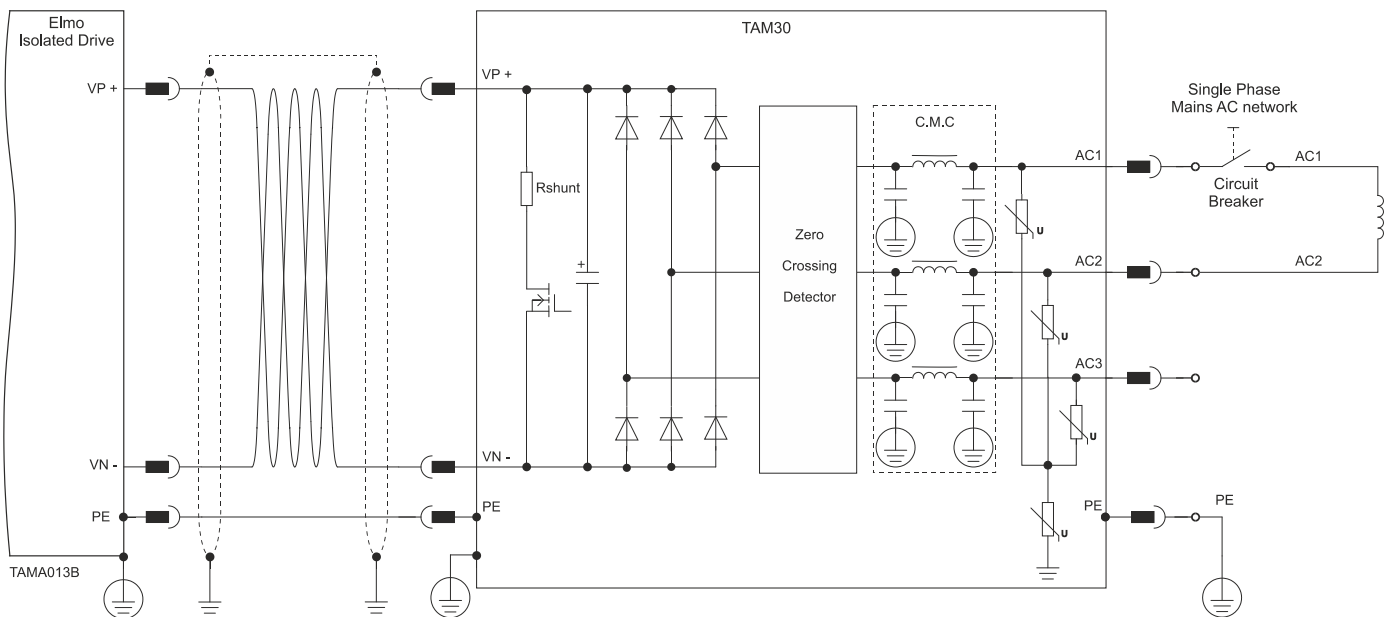


Figure 5: Single-Phase Direct-to-Mains Connection

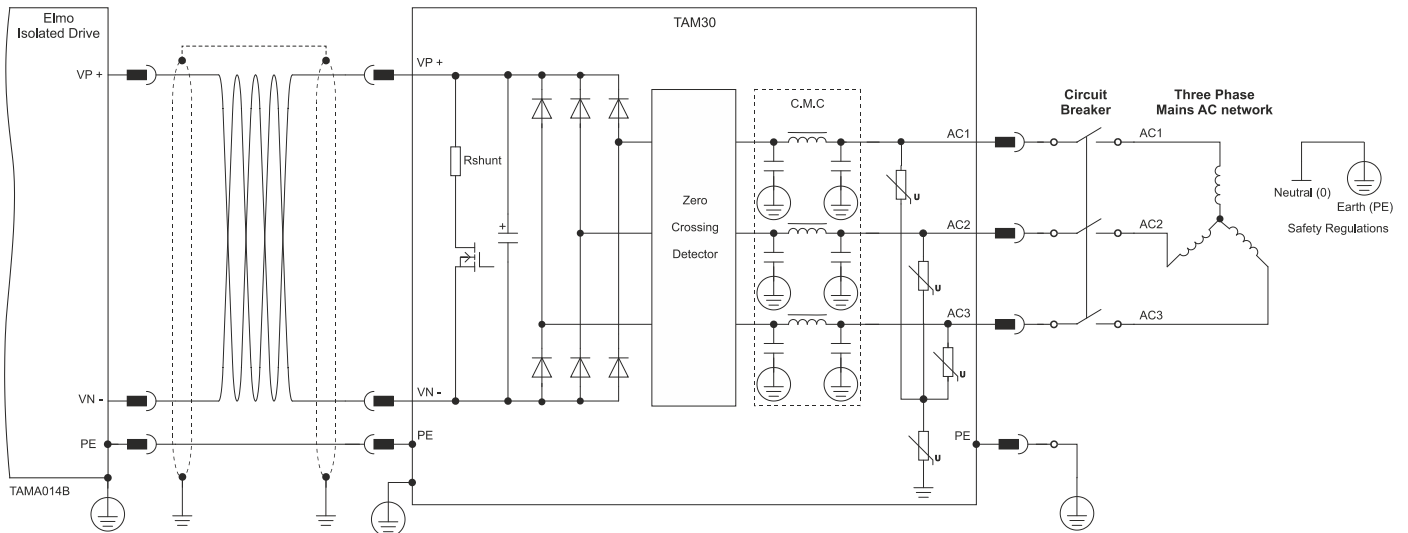


Figure 6: Three-Phase Direct-to-Mains Connection

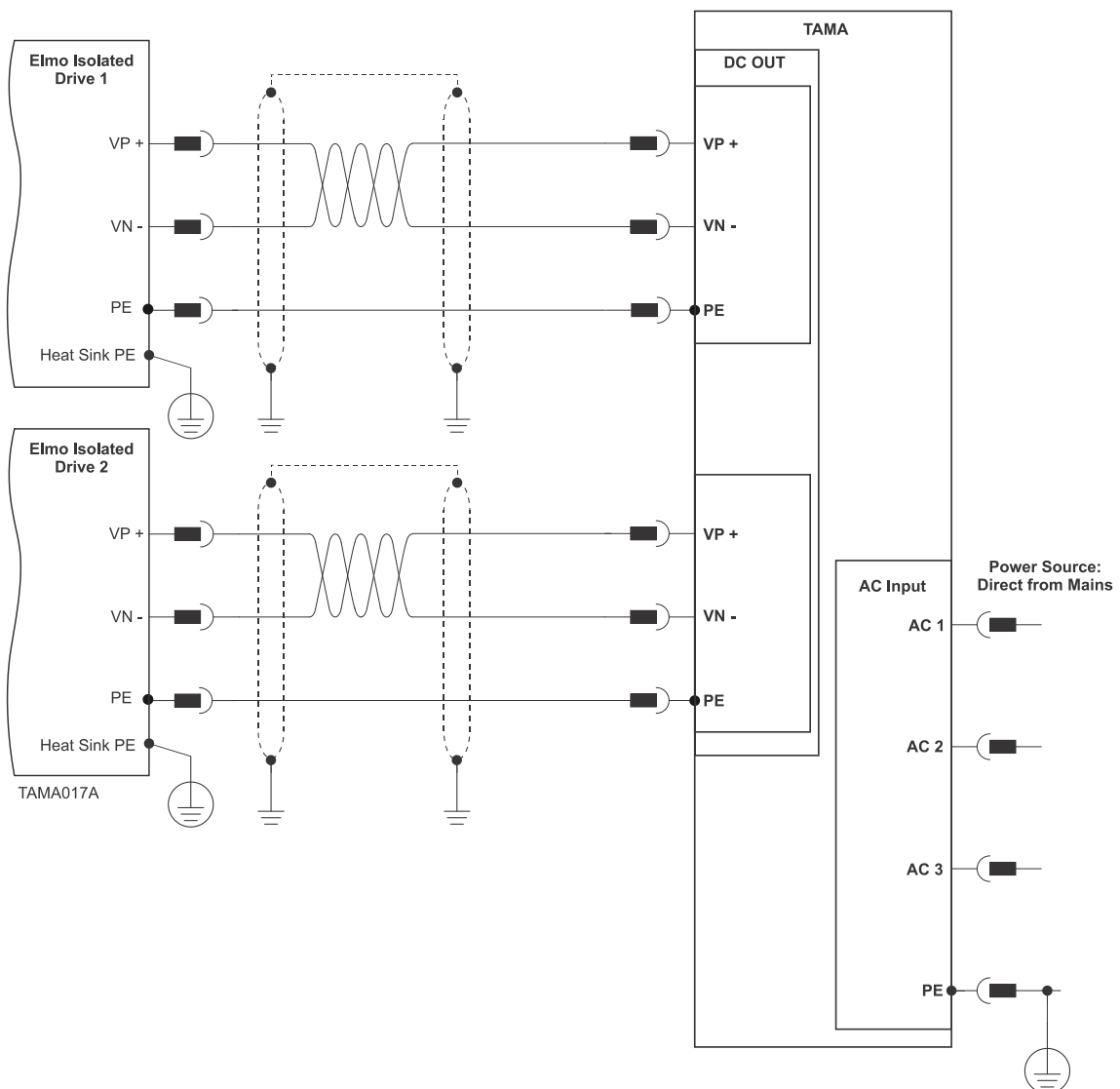


Figure 7: Multiple Direct-to-Mains Connection



### 3.4.5. Isolated AC Supplies (with an Isolation Transformer) Wiring Diagrams

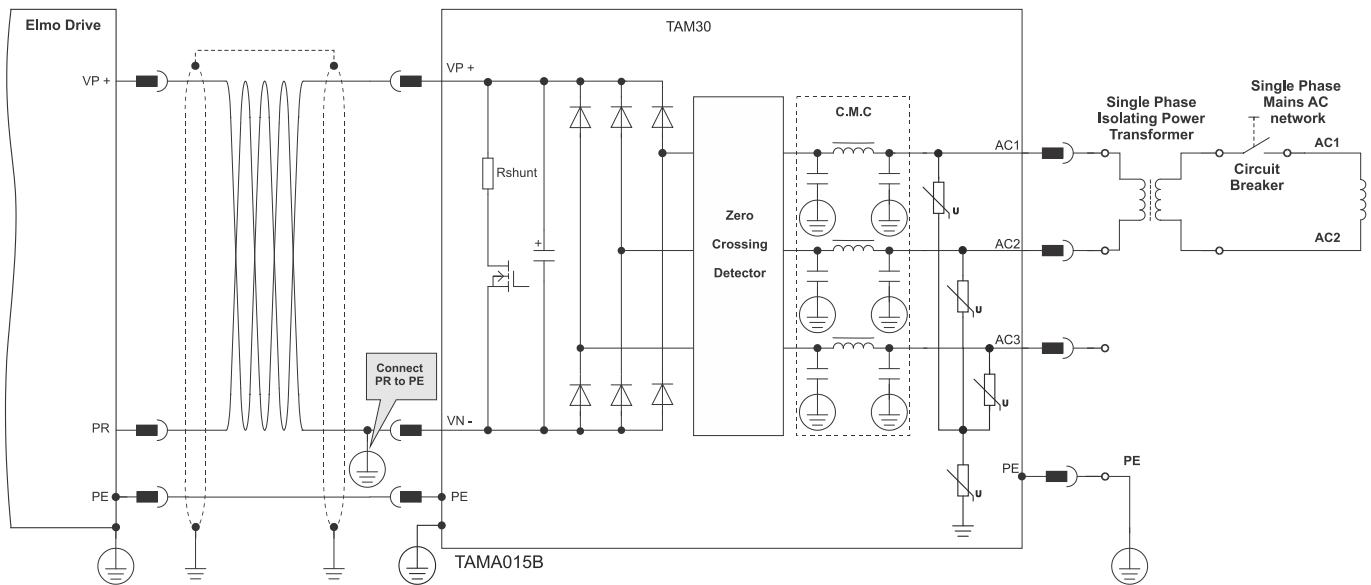


Figure 8: Single-Phase Isolated Source Connection



**Caution:** When using an isolation transformer, PR and PE must be connected together on the Tambourine 30 side.

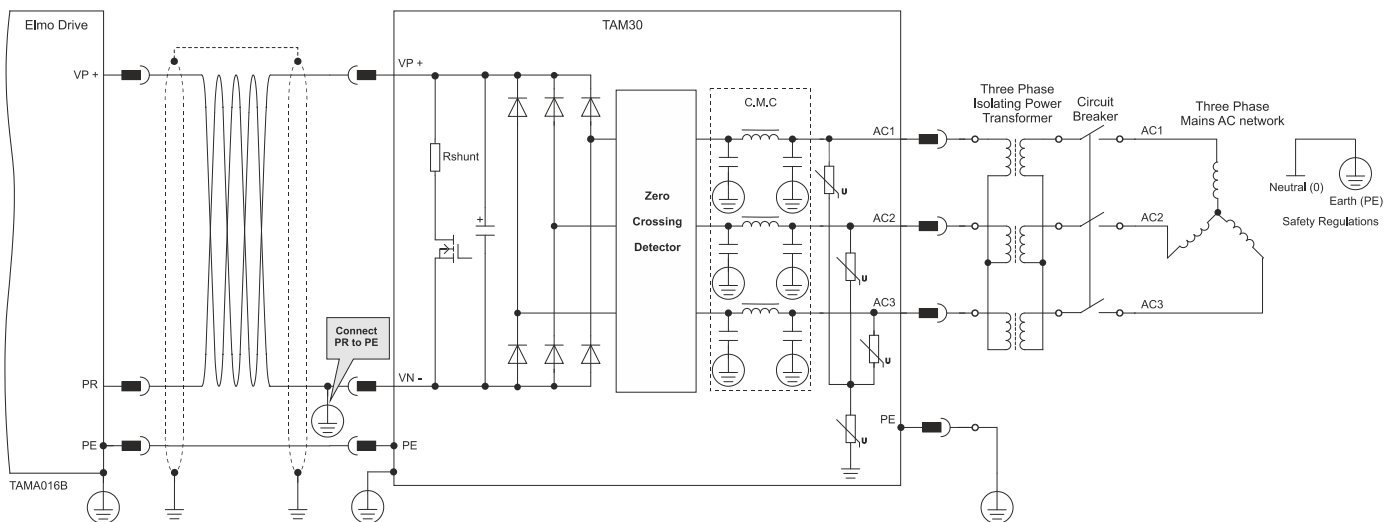
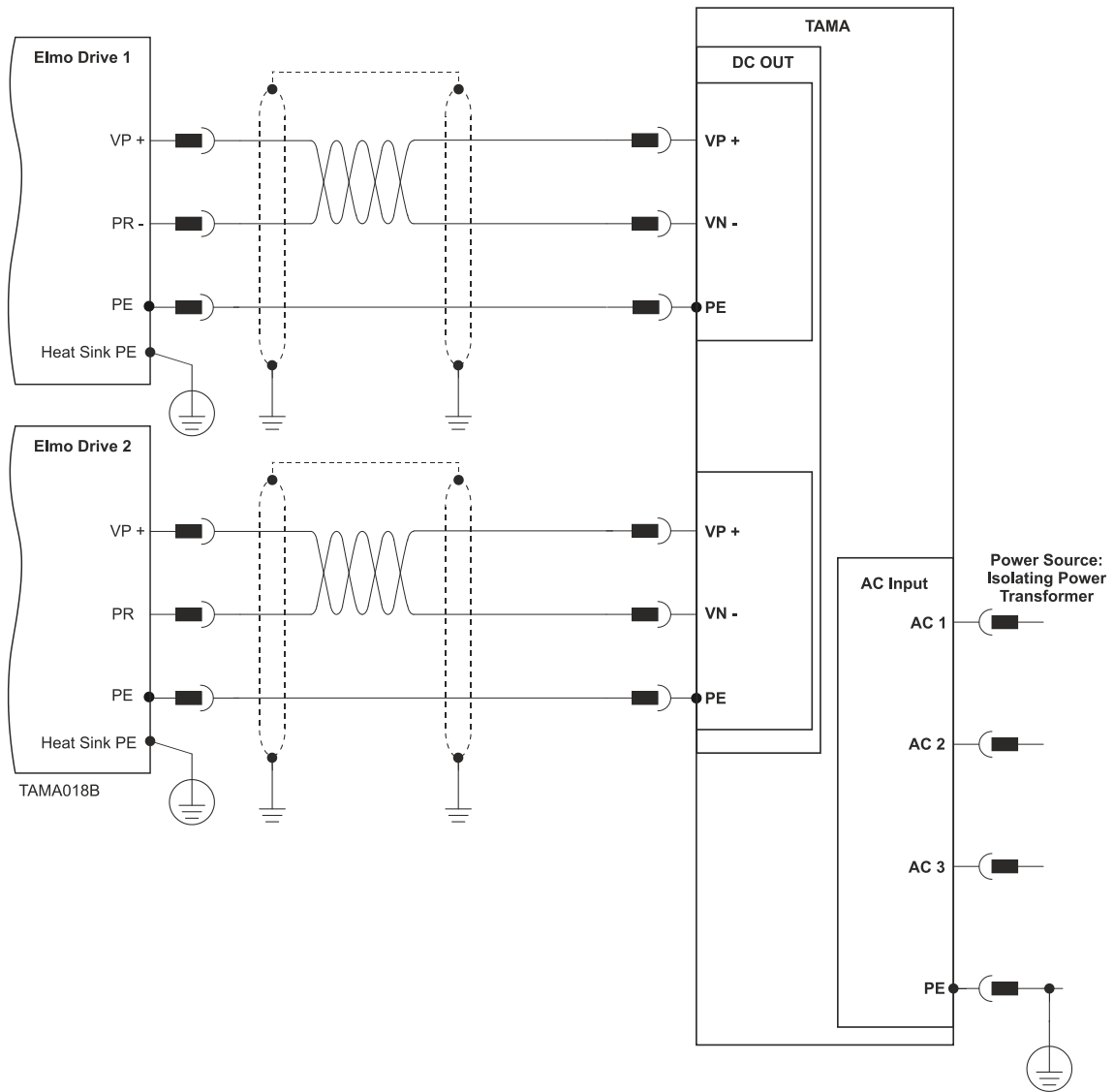


Figure 9: Three-Phase Isolated Source Connection



**Caution:** When using an isolation transformer, PR and PE must be connected together on the Tambourine 30 side.



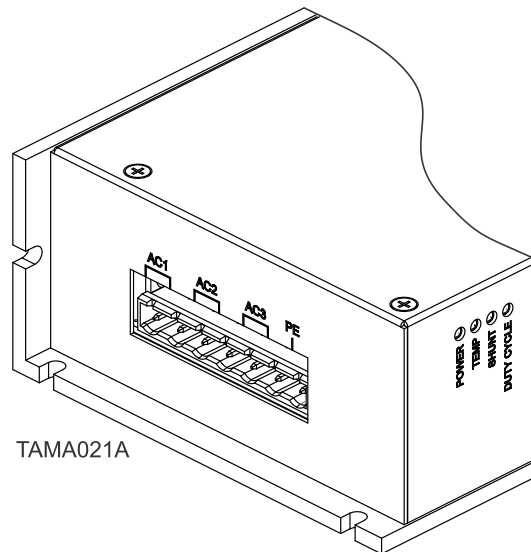


**Figure 10: Multiple Isolated Source Connection**

All wiring guidelines for supply connections described previously apply to multiple-Tambourine 30 connections.



### 3.4.6. Connecting the Main Power Cable



*To connect the AC power cable*

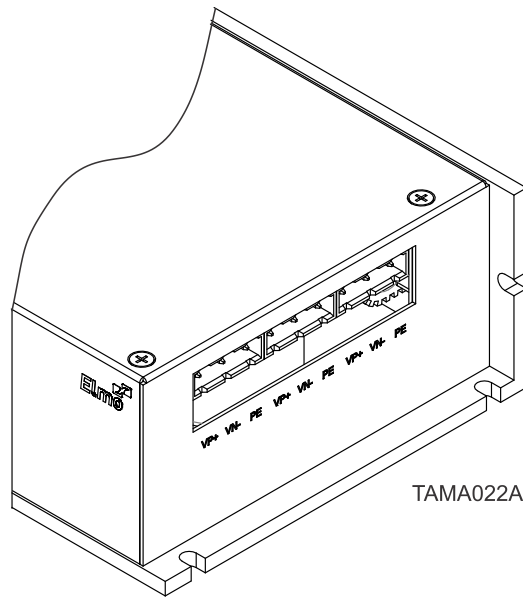
1. For best noise immunity, a shielded (not twisted) cable is recommended (not mandatory) for the AC input cable.
2. When operating with a three-phase power source, a 4-wire shielded cable should be used:
  - a. Connect the 3-phase leads of the main input cable to the AC1, AC2 and AC3 terminals of the main input connector.
  - b. For safety requirements, the green/yellow-wire must be connected to the protective earth (PE terminal). Connect the Protective Earth wire to the PE terminal on the main input connector.

When operating with a single-phase power source, a 3-wire shielded cable should be used:

- a. Connect the first phase lead of the main input cable to the AC1 terminal of the main input connector. The second lead can be connected into either terminal AC2 or AC3.
  - b. For safety requirements, the green/yellow-wire must be connected to the protective earth (PE terminal). Connect the Protective Earth wire to the PE terminal on the main input connector.
3. The gauge of the cable strands is determined by:
  - a. For three-phase source, the sum of the actual current consumption of the drives being fed by the Tambourine 30.
  - b. For single-phase source, twice the sum of the actual current consumption of the drives being fed by the Tambourine 30.



### 3.4.7. Connecting the DC Output Cable



*To connect the DC output cable*

1. For best noise immunity, a shielded and twisted cable is recommended (not mandatory) for the DC output cable. A 3-wire shielded cable should be used. The gauge is determined by the actual current consumption of the drives being fed by the relevant DC output.
2. Connect the three wires of the DC output cable to the DC output connector of the Tambourine 30:
  - a. Connect the DC leads to the VP+ and VN- terminals of the DC output connector.
  - b. For safety requirements, the third green/yellow-wire must be connected to the protective earth (PE terminal). Connect the Protective Earth wire to the PE terminal on the DC output connector.
3. When the Tambourine 30 is fed from an isolation transformer, from the safety and EMI aspects, the PR (VN-) junction must be connected to PE junction.



### 3.4.8. DC-Link Shared Connection

Each Tambourine 30 contains a shunt. Its purpose is to "absorb" regenerated energy created by the motor during braking and convert that energy into heat. If the energy regenerated by the motor exceeds the capacity of the shunt, the drive is inhibited and an overvoltage message is sent.

To prevent this from happening, the braking-capacity of the shunt system can be extended by connecting the DC output of several Tambourine 30 power supplies in parallel. When two or more Tambourine 30 power supplies are connected, by DC Link cables, the regenerated energy is distributed among them. This spreads the energy spikes over several shunts and enables the application to continue normal operation, and avoid overvoltage interruptions.

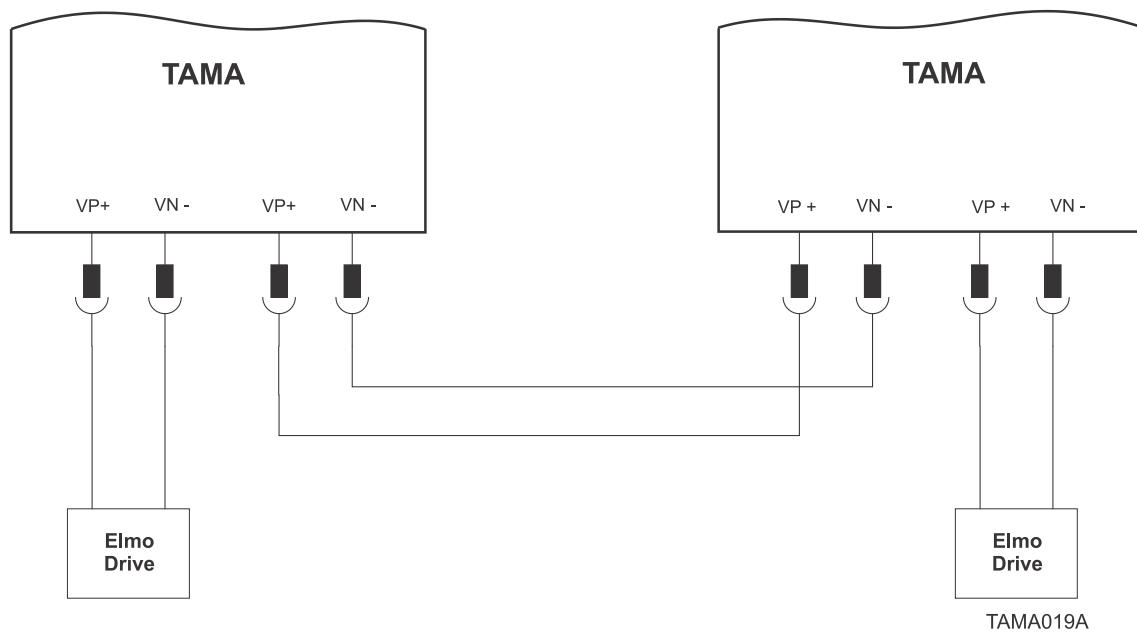


Figure 11: The Tambourine 30 Power Supply External DC Link Option



**Caution:** The two Tambourine 30 power supplies must have an identical voltage rating.



### 3.5. Heat Dissipation

For full power output capability the Tambourine 30 is designed to be mounted on an external heat-sink. It is highly recommended that the “Wall” on which the Tambourine 30 is mounted will have heat dissipation capabilities. The Tambourine 30 at “free air convection” (without an additional heat-sink) can dissipate around 12 W for 40°C ambient temperature and not exceeding 85 °C on the heat sink.

When “Free Air Convection” is sufficient for the application it is recommended to leave approximately 10 mm of space between the Tambourine 30's heat sink and any other assembly.

When attaching to an external heat-sink, it is recommended to use N5-N7 surface treatment and thermal foil or smearing thermal compound.

#### 3.5.1. Tambourine 30 Thermal Data

- Free air convection thermal resistance ( $\theta$ ): Approximately 5 to 6°C/W.
- Thermal time constant: Approximately 20 minutes/ 1200 seconds (thermal time constant means that the Tambourine 30 will reach 2/3 of its final temperature after 20 minutes).
- Self-heat dissipation capability (no external heat sink): 12 W for 40°C/W temperature rise.
- The thermal resistance when connecting to an external heat sink using a thermal conductive compound/foil. By proper smearing of the surface a significant improvement of the thermal resistance is achieved: 0.03°C/W.

#### 3.5.2. Heat Dissipation Data

Heat Dissipation is shown graphically below:

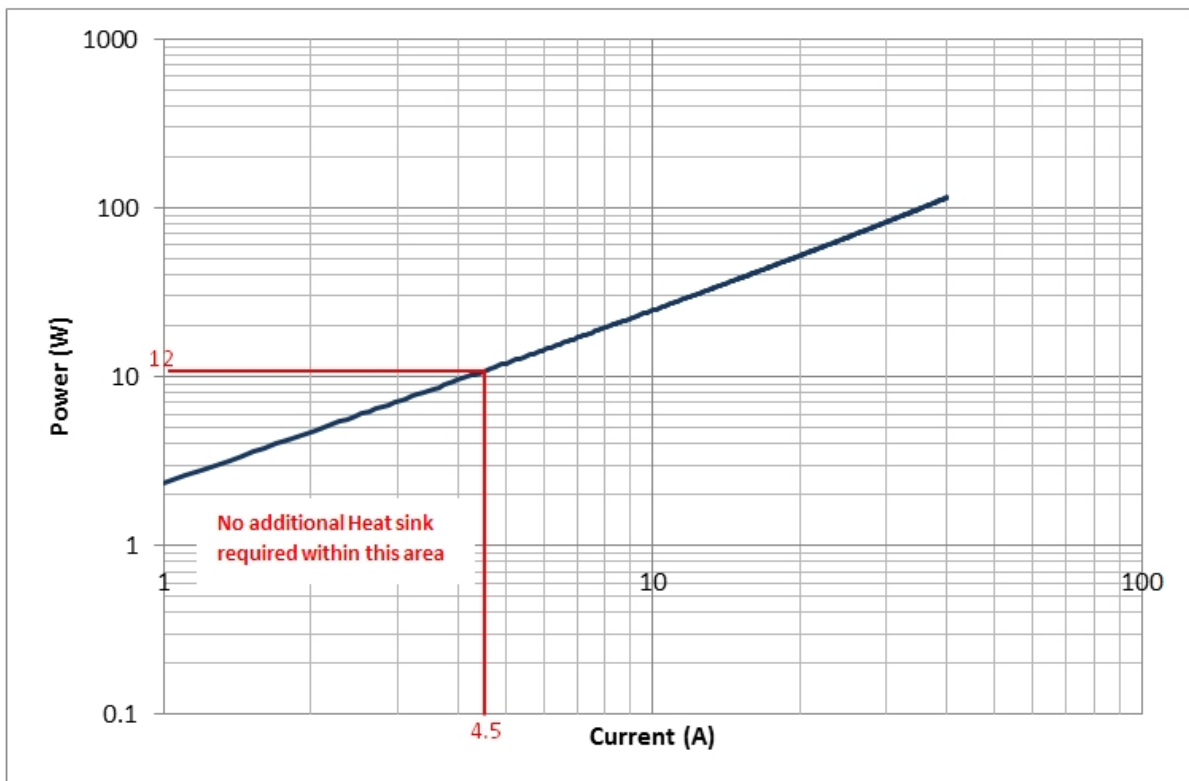


Figure 12: Dissipation versus Current Graph



### 3.5.3. How to Use the Charts

The charts above are based upon theoretical worst-case conditions. Actual test results show 30% to 50% better power dissipation.

**To determine if your application needs a heat sink:**

1. Allow maximum heat sink temperature to be 85 °C or less.
2. Determine the ambient operating temperature of the Tambourine 30 as  $\leq 40^{\circ}\text{C}$ .
3. Calculate the allowable temperature increase according to the following example: For an ambient temperature of 40 °C,  $\Delta T = 85 \text{ to } 40^{\circ}\text{C} = 45^{\circ}\text{C}$
4. Use the chart to find the actual dissipation power of the drive. Follow the curve to the desired output current and then find the dissipated power.



## Chapter 4: Initialization

### 4.1. LED Diagnostics

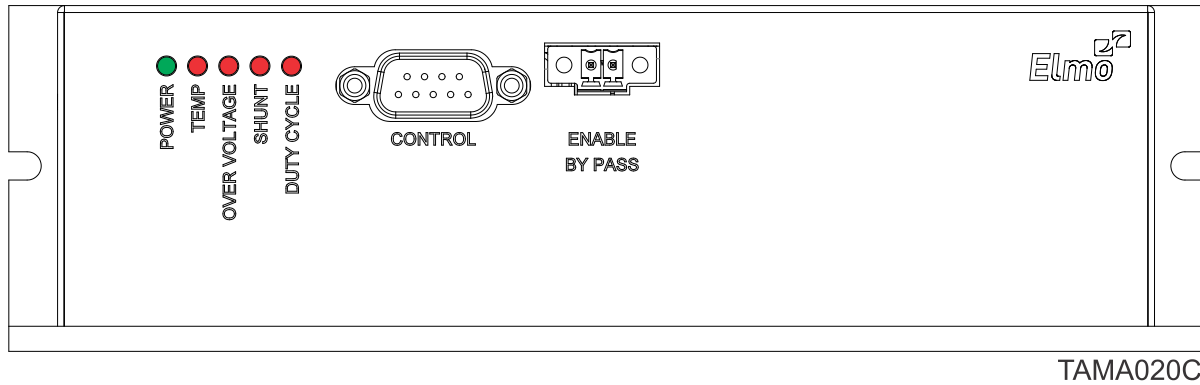


Figure 13: Power LED Indicators

The following indication LEDs are mounted on the front panel of the Tambourine 30 (Figure 12):

LED	Color	Indication
POWER	Green	Internal supply presence
TEMP	Red	Light is on when the temperature rises above 80 °C. The rectifier is Disabled, and thus there is no DC output.
OVER VOLTAGE	Red	The AC input voltage exceeds the allowed voltage.
SHUNT	Red	Shunt is on (blinks whenever the shunt is activated)
DUTY CYCLE	Red	The Shunt is disabled when exceeding the limited duty cycle threshold (overvoltage protection may occur within the Drive).

