

Cooling Tower Drives

MARCH, 2010



Baldor Mission Statement

Baldor's Mission is...

to be the best

(as determined by our customers)

marketers, designers, and manufacturers of industrial electric motors, mechanical power transmission products, drives and generators.

$$\text{Value}_p = \frac{Q_p \times S_p}{C \times T}$$

BALDOR

Typical Applications Cooling Towers

• HVAC Commercial/Institutional

- HVAC towers pair the cooling tower with a water-cooled chiller or water-cooled condenser
- Used by HVAC systems to increase efficiency of the heat transfer process
- Typical range: 25 - 75 Hp
- Applications:
 - Office Buildings
 - Hospitals
 - Convention Centers
 - University Buildings
 - Shopping Malls



• Industrial Processing & Power Plants

- Remove heat absorbed in circulating water cooling systems from various sources such as machinery or process materials
- Cool discharge water back to lakes, rivers or oceans at a safe environmental level
- Typical range:
 - Industrial: 75 – 200 Hp
 - Power Plants: 250 – 350 Hp
- Applications:
 - Power Plants
 - Petro Chemical
 - Petroleum Refineries
 - Natural Gas
 - Food Processing

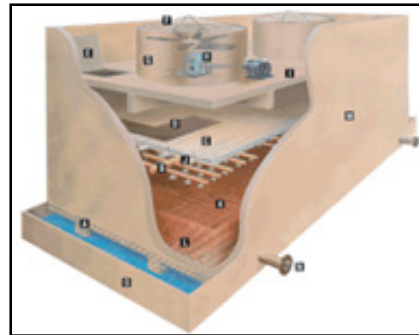
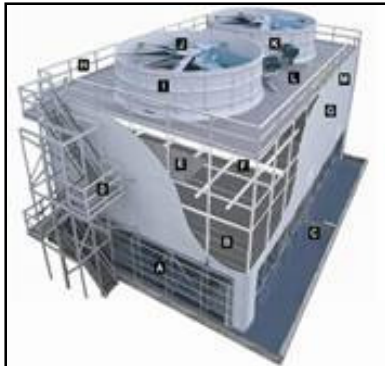


BALDOR

Cooling Tower Designs

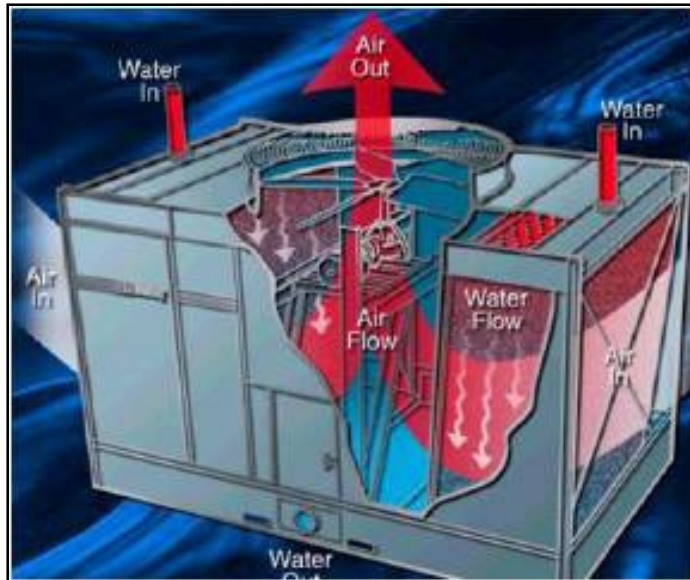
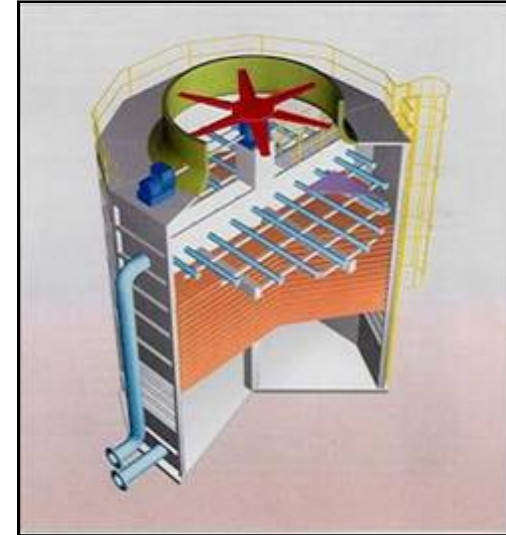
Field Erect Units

Packaged Units



Conventional Cooling Tower Control

- **Traditional mechanical components:**
 - Motor (typically 1800 RPM)
 - Gearbox
 - Pillow block bearing
 - Fan Impeller
 - Drive shaft
 - Disc Coupling
- **Cooling Towers are heat exchange systems**
 - Remove waste heat from a type of fluid



Fan Operation

- Fan speed determined by the diameter of the blades
- Cell design keeps the tips of the fan blades at a safe speed
- Typical rotation is 90 to 230 RPM
- To prevent freezing in cooler climates the fans may reverse

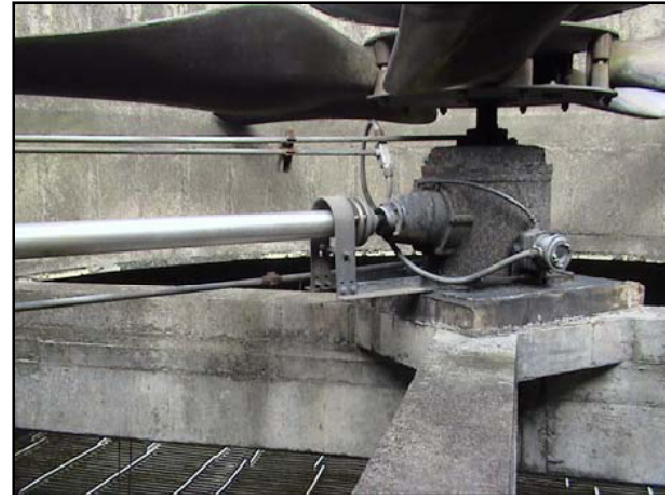
BALDOR

Conventional Mechanical Issues

- **High Mechanical Maintenance**

More components to fail over time:

- Gearbox failures
- Oil leaks & contamination
- Failed & misaligned drive shafts
- Excessive vibration
- Additional replacement time due to large mounting frame



- **Conventional Cooling Tower Control**

- Lightly loaded majority of the time
- Peak load for short durations
- Started across the line
 - High inrush currents
 - Mechanical stresses

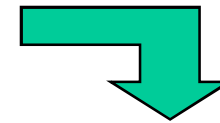
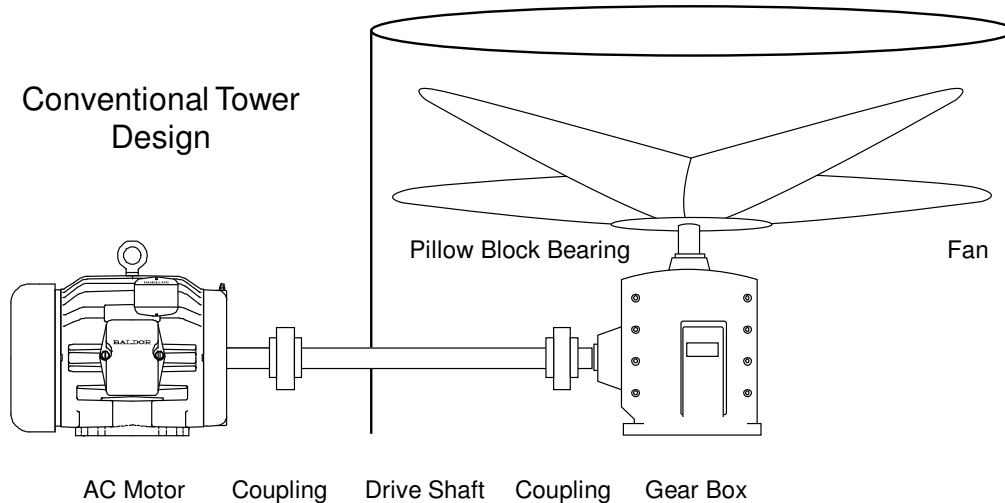
New Direct Drive Technology

- Matched Performance VS1CTD drive and RPM-AC Motor
- Baldor VS1CTD drive designed for variable speed operation
- High Torque Direct Drive Motor:
 - Laminated Frame IPM (Permanent Magnet)
 - Motor is designed as a drop in replacement for existing gearbox packages; matching bolt holt patterns
 - Water tight motor uses fan air stream for optimal cooling
 - Improved efficiency over standard gearbox and motor
- Fan couples directly to the motor shaft

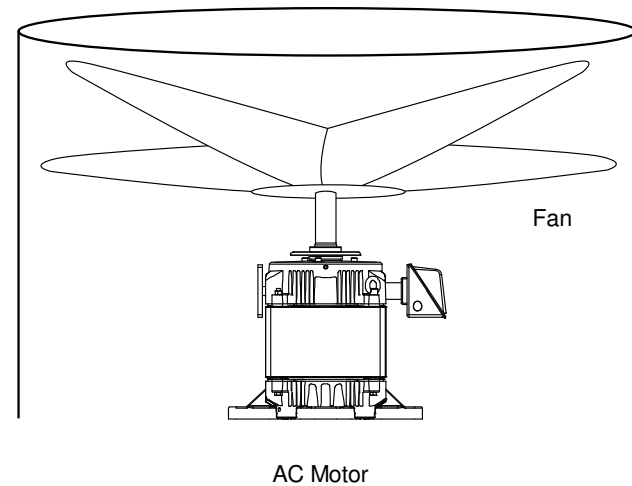


BALDOR

Eliminate High Maintenance Components



New Direct Drive Tower Design



Benefits:

- Eliminates gearbox, jack shaft, pillow block bearings and couplings
- Runs Quieter & Saves Energy
- Increases safety due to fewer components
- Improves reliability & reduces maintenance
- Lower installation cost by eliminating alignment issues of mechanical components
- Reduces cooling water contamination from gearbox oil and leakage

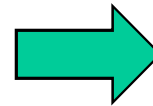
BALDOR

Direct Drive Cooling Tower Install

- **Installation process simplified**
 - Basic assembly is smaller and easier to lift into place
 - Weight is center distributed to load making the installation process safer
 - One piece fit into existing cooling tower
 - Field tested (Clemson University conversion made in less than a day)



Conventional Tower Design



New Direct Drive Tower Design

Cooling Tower Motor



PM Motor Improvements

- **Industry requires improved motor power density and increased efficiency**
- **Permanent Magnet Motors meet these needs**
 - Due to dramatic improvements in PM materials, these types of motors are now viable alternatives to standard induction motors
 - Laminated RPM-AC frame allows more room for active material creating a power dense package
 - Frame construction improves thermal transfer and heat dissipation capability of the motor
 - Efficiency of PM motors is a band level higher than induction cast iron frame motors
- **Mechanical Advantages:**
 - Greased bearings only need inspection every few years
 - RPM-AC motors run at slow speed eliminating excessive vibration from the system
 - Noise levels for PM motors are reduced over the traditional cooling tower design

Direct Drive Cooling Tower Motor

- **Laminated Frame Interior Permanent Magnet rotor technology**
 - Motor is compact enough to direct drive cooling tower fans
 - Finned Laminated frame in fan air stream is optimum construction for application
 - VPI electrical insulation system for extreme environmental conditions
- **Mechanical Advantages:**
 - Drop in replacement for gearbox
 - Fan mounted directly to RPM-AC motor replacing conventional pillow block bearings
 - Tower fan air flow cools motor:
 - Provides superior cooling over traditional mounting
 - Lower temperatures produce longer motor life



BALDOR

Cooling Tower Motor Features

- **Sealed insulation system:**
 - Same insulation system used in off shore oil drilling motor applications
 - Provides ultra reliable motor life in hostile north sea environment
- **Drive end sealing utilizes a slinger and an Inpro seal for superior bearing protection.**



BALDOR

Clemson Beta Site Motor

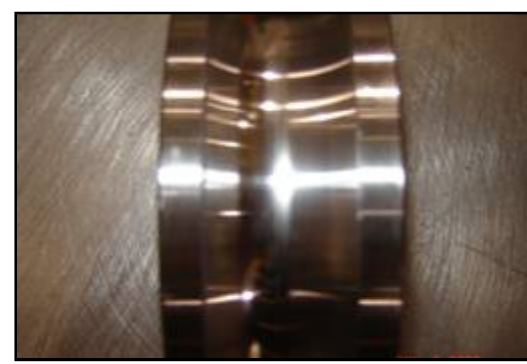
- Test conducted after approximately 1-year of operation
- This test motor did not have E-coat or Flinger cover over Inpro seal
- After 1-year of operation still in good condition



BALDOR

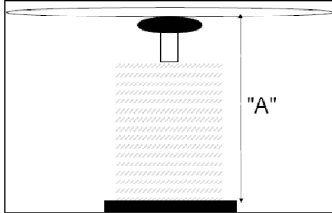

Clemson Motor Inspection Results

- Grease was still in excellent condition
- Bearings showed only minor wear
- Ingress of contamination was minimal
- Insulation was still in excellent condition



RFQ Data Sheet

- Please have data sheets filled out when sending in Quote requests
- Fan Shaft Hp required
- Presently assuming a required min air flow over motor of 500 fpm for 250 frame & 750 fpm for larger frames. This is one of the inputs required.
- We will run an evaluation of the application.

Baldor Cooling Tower Motor RFQ			
Company Name: _____	Project : _____		
Fan Diameter (ft.) _____	Air Flow (cfm) _____		
Fan Speed (RPM) _____	Ambient Temp _____		
Existing Motor Hp _____	Static Pressure _____		
Fan Shaft Hp _____	(inches of H2O) _____		
This is normally an odd number ex: 42.3 Hp	Air Density(lb/ft^3) _____		
Based on operating conditions	Fan mfg P/N. _____		
Voltage required _____	No. Fan Blades _____		
Height Restriction? Yes / No _____	"A" (inches) _____		
If Yes, please give maximum height from motor mounting plate to shaft extension (see diagram - "A" dimension)			
Match Existing Bolt Hole Pattern? Yes / No _____			
If Yes, please give existing Bolt Hole Pattern _____			
Air Velocity in Region of Motor (ft/min) _____			
(shaded area shown below).			
If retrofit.....			
Gearbox Manufacturer _____			
Gearbox Model No. _____			
The Baldor Solution requires a Baldor CTPM Drive			
Approximate distance from motor to drive location _____	Feet		
	Fan Shaft Dia	Keyway	
	1.999" +/- .0005"	1/2" x 1/4"	
	2.374" +/- .0005"	5/8" x 5/16"	
	2.624" +/- .0005"	5/8" x 5/16"	
	2.999" +/- .0005"	3/4" x 3/8"	
Other Shaft Dia Requirements		_____	_____
Questions regarding above information Please contact local Baldor District Office			

BALDOR

Review CT Application

- Fan Dia
- Existing Motor Hp
- Voltage
- Gearbox
- Height Restriction (YES / NO)
- Will the drive be in a control room or outside
- Customer name & location

If all you have is Hp and RPM of fan you can quote but be careful. You might get a motor and drive on site that won't FIT !!!!

BALDOR

Cooling Tower Drive



Baldor VS1CTD Drive

- **Designed for the cooling tower industry**
 - Focus is on ease of startup, minimal maintenance and efficiency of operation
- **Matched Performance drive and motor**
 - RPM-AC motor models are stored in the VS1CTD drive software
 - Precise control capability
 - Simplified Cooling Tower Startups
 - Eliminates the need for users to input data
 - Basic software parameter set designed exclusively for the cooling tower industry
- **Designed around proven H2-Technology**
- **Unique Sensorless Vector Software**
 - Smooth, low speed operation
 - Optimized motor control increases efficiency



VS1CTD Ratings

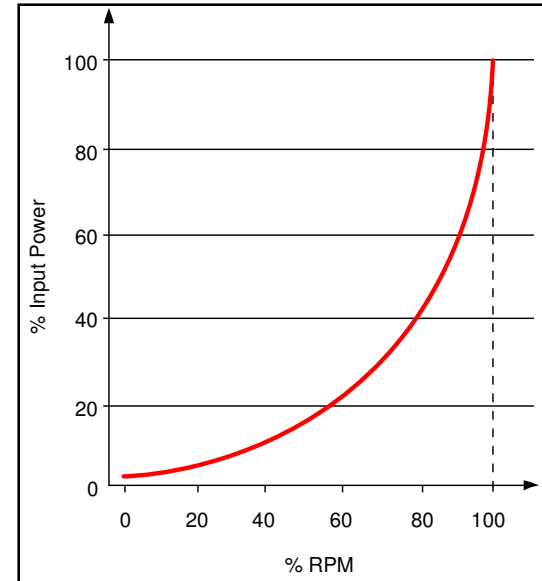
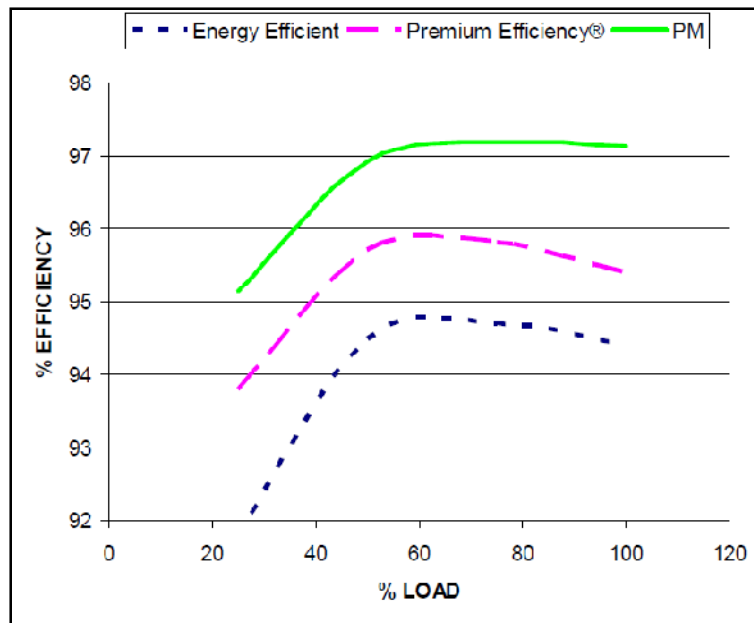
Catalog Number	Input Volts	Frame Size	Normal Duty (Standard 4kHz PWM)				
			Input Amps	Output			
				HP	kW	IC*	IP*
VS1CTD47-1B	480	AA	11.9	7 ½	5.6	11.9	13.7
VS1CTD410-1B	480	AA	11.9	10	7.5	11.9	13.7
VS1CTD415-1B	480	B	23.0	15	11	23.0	26.4
VS1CTD420-1B	480	B	28.9	20	15	28.9	33.2
VS1CTD425-1B	480	B	34.0	25	18.7	34.0	39.1
VS1CTD430-1B	480	C	44.2	30	22.4	44.2	50.8
VS1CTD440-1B	480	C	55.3	40	30	55.3	63.5
VS1CTD450-1B	480	C	65.5	50	37	65.5	75.3
VS1CTD460-1B	480	D	90.8	60	45	90.8	104.4
VS1CTD475-1B	480	D	116.6	75	56	116.6	134.0
VS1CTD4100-1B	480	D	136.3	100	75	136.3	156.8
VS1CTD4125-1B	480	D	143.8	125	93	143.8	165.4
VS1CTD4150-1T	480	E	204.0	150	112	204.0	234.6

* The column labeled IC indicates the continuous output current rating of the control and the column labeled IP indicates the peak output current capability of the control for 1 minute.



Optimized Efficiency

- **Optimized motor speed**
 - Traditional cooling towers are designed for the “Worst Case” (highest air flow) scenario
 - Running the fan at reduced speed saves energy and cost of operating the tower
 - Allows for optimized cooling of return water; increasing the efficiency of compressor operation and this components life



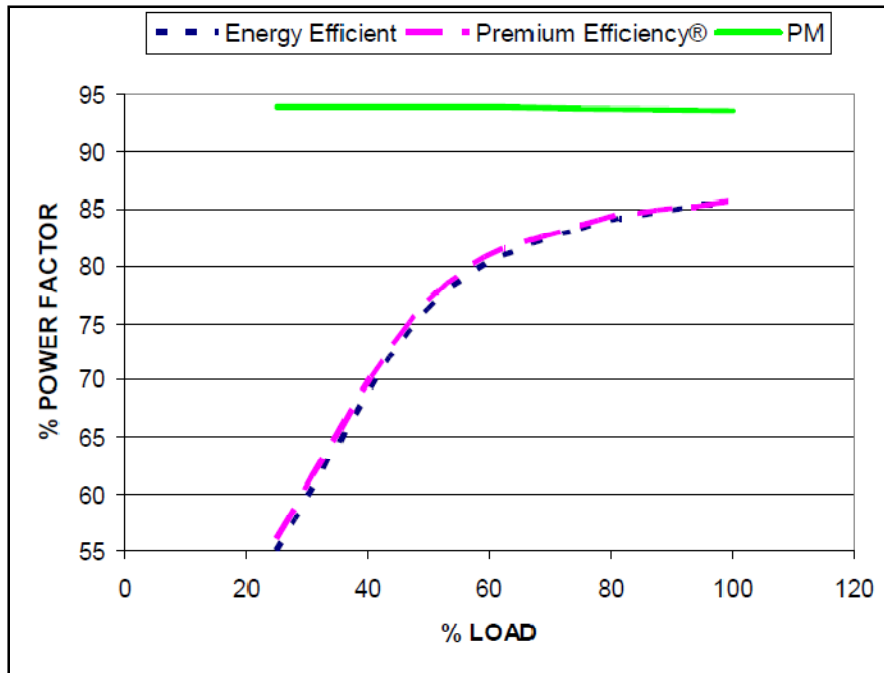
- **IPM Motor Highest Industry Efficiency**
 - Permanent Magnet Motors provide the highest efficiency levels of any motor in the industrial market
 - IPM Motors are fully one band higher than premium efficient motors

BALDOR

Partial Load Power Factor

- **Cooling Tower Loading**

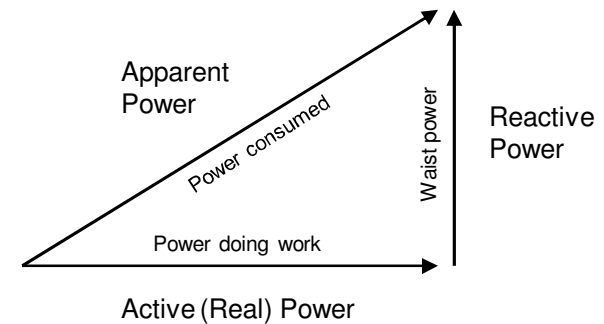
- Typical cooling fans run the majority of their time lightly loaded
- Traditional AC motor power factor is negatively impacted by light loading



- **IPM Motor**

- Highest Industry Power Factor**

- Permanent Magnet Motors provide high power factor even on light loads
- Power factor measures the ratio of real power to apparent power
- Higher power factor allows lower amps to do the same amount of (real) work



$$\text{Power Factor} = \text{Real Power} / \text{Apparent Power}$$

BALDOR

VS1CTD Parameters

- **Reduced Parameter Set**

- 25% of the normal parameters are available to the user by default
- Security access required to access more parameters for unique installations
- Documented in Reference Manual



- **Menu Structure similar to other VS1 products**
- **Main Menu**
 - Status
 - Basic Parameters
 - Advanced Programming
 - Event Log
 - Diagnostics
 - Display Options
- **Advanced Programming**
 - 3 Programming Levels
 - Modified Parameters
 - Parameter Linear List

BALDOR

VS1CTD Operating Modes

- **The VS1CTD is simplified; only 5 operation modes:**
 - Keypad
 - Process Control
 - Network
 - CTD 2Wire (provides 2-wire terminal strip control)
 - CTD 3 Wire (provides 3-wire terminal strip control)
- **The VS1CTD does not use Autotune**
 - Critical motor parameters are integrated into the VS1CTD firmware to provide rapid cooling tower startups
 - Existing motor design (uses a firmware database)
 - New motor design
 - Use custom motor block
 - Parameters are integrated into motor data sheet



BALDOR

VS1CTD Trickle Current Heating

- **Trickle Current Heating is used to keep the temperature of the motor above the dew point during times when not in use.**
- **Set by a single parameter (units of amps)**
 - Limited to 50% FLA of motor (0 amps disables)
 - Wattage calculation based upon amperage and motor stator resistance
- **Enabled automatically once motor stops and after a 300 second delay**
 - Digital input provided for customers that want control via hardware input for CTD operating modes
 - Modbus coil provided for building automation control systems
- **Additional benefit of providing anti-windmilling torque**



**NO SPACE
HEATERS
REQUIRED**

VS1CTD Accessories and Options

- **Communication Networks:**
 - System automation and control can be a requirement for cooling tower operations
 - The VS1CTD communicates with multiple networks:
 - BACnet
 - DeviceNet
 - Metasys N2
 - EtherNet/IP
 - LonWorks
 - PROFIBUS-DP
 - Modbus-TCP
 - LonWorks (available soon)
- **Dynamic Braking**
- **Input / Output Reactors**
- **Keypad Extension Cables**
- **High Resolution Analog I/O Expansion Board**
- **Ethernet Browser Board**



Cooling Tower Resource Material



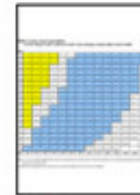
 [Manual](#)



 [Flyer](#)



 [FAQ's](#)



 [Matrix](#)



 [Paper](#)



 [RFQ](#)



 [AD](#)



 [Story](#)



 [Photos](#)



 [Brochure](#)

BALDOR

Web Site Information

www.baldor.com



QUICK LINKS
--- Select Link ---

PRODUCT QUICK SEARCH
Catalog OR Spec Number... **Go**

DODGE
[visit site](#)

Save Green - Go Gold!
Energy Efficiency
See how it can work for you.

Check SCAM Targeting Baldor

BALDOR NEWS
Baldor Servo Drives simplify construction of automotive component tester...[more](#)
Baldor Receives Plant Engineering Gold Product of the Year Award...[more](#)

NEW PRODUCTS
Baldor Announces New Cooling Tower Control System
The present and future market for drives and motors places a high value on operating efficiency, reliability, flexible control, low running temperature, quiet operation and low cost. Permanent magnet (PM) motors are able to meet the market expectations across a wide range of ratings. One such application is Cooling Tower control...[more](#)

BaldorVIP Account Login
UserID:
Password:
Log In [Welcome to the BaldorVIP site. For more information about becoming a BaldorVIP, please click here.](#)

SUPPORT
SupportMe Site
Download latest software, firmware, and documentation for Baldor Motion Controllers and Servo Drive products.
Customer Education schedule ...[click here](#)

INVESTOR NEWS
[Baldor Q2 2009 Earnings and Conference Call](#)
Baldor reports Q3 2009 Dividend...[more](#)

BALDOR

Web Site Information

New Products

[<< Return to list](#)

Baldor Announces New Cooling Tower Control System

Introduction

The present and future market for drives and motors places a high value on operating efficiency, reliability, flexible control, low running temperature, quiet operation and low cost. Permanent magnet (PM) motors are able to meet the market expectations across a wide range of ratings. One such application is Cooling Tower control.

Baldor has designed the Cooling Tower Control system around a specially designed permanent magnet motor that is a drop in replacement for existing mechanical packages. When coupled with the power matched VS1CTD Cooling Tower Drive this system provides unparalleled efficiency and reliability.



Features

- Increased efficiency and power factor
- Operate at optimal system efficiency point
- Increase system reliability
- Mechanical drop in replacement
- Shaft sealing protects against contamination
- Maintenance free operation
- Lube for Life bearings
- Reduced noise levels

Literature



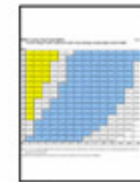
[Manual](#)



[Flyer](#)



[FAQ's](#)



[Matrix](#)



[Paper](#)



[RFQ](#)



[AD](#)



[Story](#)



[Photos](#)





[Brochure](#)

BALDOR

VS1CTD Technical Literature

- MN776 Instruction Manual
- Cooling Tower Institute Paper
- RFQ Document & Motor Frame Matrix


Baldor Cooling Tower Motor RFQ											
Company Name: _____	Project: _____										
Fan Diameter (ft.) _____	Air Flow (cfm) _____										
Fan Speed (RPM) _____	Ambient Temp _____										
Fan Shaft Hp _____	Static Pressure _____										
This is normally an odd number ex: 42.3 Hp	(inches of H2O)										
Based on operating conditions	Air Density(lb/ft ³) _____										
Voltage required _____	Fan mfg PIN _____										
Height Restriction? Yes / No _____	No. Fan Blades _____										
	"A" (inches) _____										
If Yes, please give maximum height from motor mounting plate to shaft extension (see diagram "A" dimension)											
Match Existing Bolt Hole Pattern? Yes / No _____											
If Yes, please give existing Bolt Hole Pattern _____											
Air Velocity in Region of Motor (ft/min) _____											
(shaded area shown below)											
If retrofit, _____											
Gearbox Manufacturer _____											
Gearbox Model No. _____											
The Baldor Solution requires a Baldor CTPM Drive _____ Feet											
Approximate distance from motor to drive location _____ Feet											
	<table border="1"> <thead> <tr> <th>Fan Shaft Dia</th> <th>Keyway</th> </tr> </thead> <tbody> <tr> <td>1.999" +/- .0005"</td> <td>1/2" x 1/4"</td> </tr> <tr> <td>2.374" +/- .0005"</td> <td>5/8" x 5/16"</td> </tr> <tr> <td>2.624" +/- .0005"</td> <td>5/8" x 5/16"</td> </tr> <tr> <td>2.999" +/- .0005"</td> <td>3/4" x 3/8"</td> </tr> </tbody> </table>	Fan Shaft Dia	Keyway	1.999" +/- .0005"	1/2" x 1/4"	2.374" +/- .0005"	5/8" x 5/16"	2.624" +/- .0005"	5/8" x 5/16"	2.999" +/- .0005"	3/4" x 3/8"
Fan Shaft Dia	Keyway										
1.999" +/- .0005"	1/2" x 1/4"										
2.374" +/- .0005"	5/8" x 5/16"										
2.624" +/- .0005"	5/8" x 5/16"										
2.999" +/- .0005"	3/4" x 3/8"										
Other Shaft Dia Requirements _____											
Questions regarding above information Please contact local Baldor District Office											

PAPER NO: TP99-18
CATEGORY: FANS

COOLING TECHNOLOGY INSTITUTE

RECENT DEVELOPMENTS IN MOTOR TECHNOLOGY ALLOW DIRECT DRIVE OF LOW SPEED COOLING TOWER FANS


ROBBIE MCLEVEEN
BILL MARTIN
RYAN SMITH
BALDOR ELECTRIC



The studies and conclusions reported in this paper are the results of the author's own work. CTI has not investigated and CTI expressly disclaims any duty to investigate any product, service, process, procedure, design, or the like that may be described herein. The acceptance of any technical data, technical material, or advertisement in this publication does not constitute endorsement, warranty or guarantee by CTI of any product, service, process, procedure, design, or the like. CTI does not warrant that the information in this publication is free of errors, and CTI does not necessarily agree with any statement or opinion in this publication. The user assumes the entire risk of the use of any information in this publication. Copyright 2000. All rights reserved. This paper has been reviewed by members of the Cooling Technology Institute and approved as a valuable contribution to cooling tower literature and presented by the author at the Annual Conference of CTI.

Presented at the 2004 Cooling Technology Institute Annual Conference
San Antonio, TX - February 14-17, 2004

1



VS1CTD
Cooling Tower Drive

Installation & Operating Manual MN776



VS1CTD Commercial Literature

- BR411 Brochure
- FL476 Flyer (electronic only)
- AD Reprint; Success Story and Photos

BALDOR **Success Stories**

June 1, 2009

Baldor is Redefining the Future of Cooling Tower Fan Designs with Innovative "Green" Motor and Drive Technology

For the past 20 years, Rod Applegate, the owner and president of Tower Engineering, Inc., has been searching for a better method of driving fans in cooling towers. He says he has finally found what he's been looking for in Baldor's new RPM AC® Cooling Tower Direct Drive Motor controlled by a Baldor VS1 Cooling Tower Drive.

Since 1986, Applegate's company has been designing and installing high-quality cooling towers for the large institutional market, including hospitals, universities and airports. They all use an air conditioning system that requires a cooling tower to exchange heat and return cooled water back to the chiller. These towers use large high inertia fans to pull air over a water soaked media to cool the water as part of the process. The most common method for driving the fan in modern cooling towers has been a right angle gear reducer, drive shaft, and disc coupling arrangement, along with a standard foot mounted AC motor.

"I have always wanted to get rid of these gearboxes and all of the other moving parts," says Applegate. "Misalignment, excessive vibration and noise are all inherent problems with this system. With the high speeds, the gearboxes generate too much heat and the seals and bearings can have very short lives. There are just too many things that can go wrong."

There is also a significant maintenance issue for the owner. "Scheduling up with regular oil changes of the gearbox and inspections of the flexible elements are critical," says Applegate. "Ignoring either of these two can, and has, resulted in the catastrophic failure of equipment."

Gearboxes are also prone to oil leakage around the high-speed input shaft, contaminating the tower cooling water.





New RPM AC® Direct Drive Cooling Tower Motor and Drive




BALDOR
baldor.com

BALDOR • RELIANCE



Baldor Adjustable Speed Direct Drive Cooling Tower Motor and Drive System



BALDOR

BALDOR

Application Example

On the campus of Clemson University in Clemson, SC



BALDOR

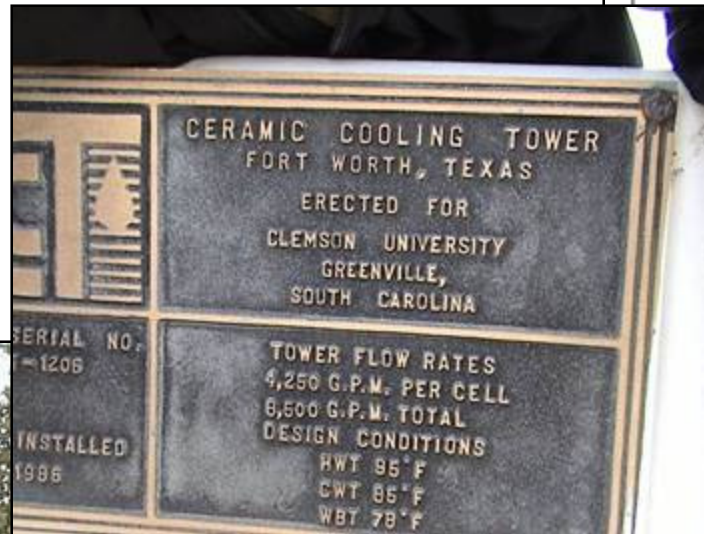
Clemson Cooling Tower

Cooling Tower Information

Built in 1986

Ceramic Cooling Tower Job # CT-1206

2 Fan Units



THE FOLLOWING
MECHANICAL EQUIPMENT
COMPONENTS
WERE FURNISHED FOR

CLEMSON UNIVERSITY
GREENVILLE, SOUTH CAROLINA

Motor:

A) Manufacturer: Reliance
B) Frame Size: 326 T

Driveshaft:

A) Manufacturer: Formsprag
B) Model: AS-35

Gear Reducer:

A) Manufacturer: Amarillo
B) Model: #155
C) Ratio: 8.5 to 1

Fan:

A) Manufacturer: Hudson
B) Model: APT-18B-5
C) Diameter: 18'-0"

Miscellaneous Hardware:

A) Murphy Model: EL-175-EX Oil Level Switch
B) Robertshaw Model: 366 Vibration Switch
C) VSM Module: STD 230/115-15 Vibration Start Time Delay Module

COOLING TOWER INSPECTION, MAINTENANCE AND PROCEDURES GUIDE

SECTION	REVISION 0	CERAMIC COOLING TOWER COMPANY	JOB NO. CT-1206
CT-1206-200	4/02/86	a subsidiary of Ingersoll Rand, Inc.	



Clemson Cooling Tower

Existing Motor Nameplate Information

Both Units were Reliance Motors

Motor 1 S/O: 1MOF26353-G1-WM

Motor 2 S/O: 1MOF26353-G2-WM

Frame Size: 326T

Rating: 50HP @ 1765 RPM / 12.5 HP @ 885 RPM

480 V / 3 Phase / 60 Hz



Clemson Cooling Tower

Amarillo Gear Box Information

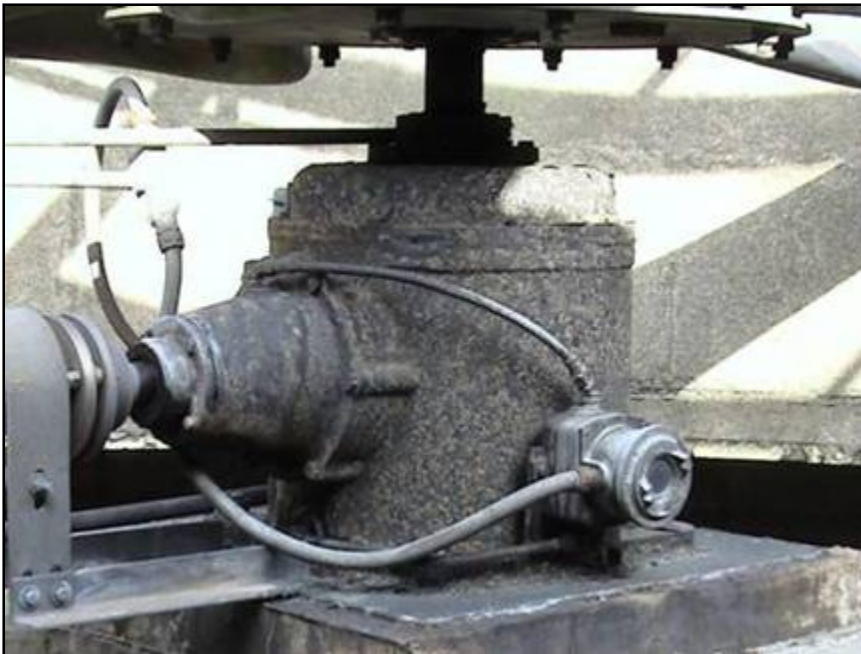
2 Units

Model: 155 (single reduction)

Gear Ratio: 8.5 to 1

Pinion: 8 Teeth

Ring Gear: 68 Teeth



Amarillo® Gear Company

TABLE I - SINGLE REDUCTION

Service Horsepower Ratings (Service Factor = 2.0)

Model	Input RPM	Ratio																	
		2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	11.0	
85	1750	25	25	20	18	17													
	1450	21	21	17	15	14													
	1150	17	17	13	12	11													
85	1750	50	48	42	43	39	36	33	30	27	26	23	22	21	17	15	12	12	
	1450	41	40	37	36	32	30	27	26	23	22	21	17	15	12	12			
	1150	33	32	30	29	26	24	22	21	19	18	17	13	12	10	10			
110	1750					74	72	71	69	64	60	46	40	33	30	25	24		
	1450					42	41	40	39	37	33	30	27	25	21	20			
	1150					30	29	28	27	26	23	21	17	15	12	12			
135	1750					120	117	115	100	93	88	83	71	65	59	48	43	42	
	1450					82	81	80	69	65	61	51	44	40	33	29	25	25	
	1150					60	59	58	50	47	44	36	30	27	22	20	20	20	
155	1750					133	129	128	114	110	104	90	83	75	70	62	54	41	
	1450					93	91	90	78	75	71	60	52	47	40	34	29	29	
	1150					68	67	66	57	54	51	42	36	32	26	22	20	20	
175	1750					145	140	133	126	112	105	90	80	70	60	40	40	40	
	1450					100	96	91	84	74	68	57	49	42	35	30	25	25	
	1150					74	71	67	62	54	49	41	34	29	24	20	17	17	

Choose models & ratios in outlined area for standard price and delivery. Contact factory for all others.

Amarillo Gear Company reserves the right to make design modifications to our gear drives that may change the given dimensions. The dimensions shown in this brochure may not exactly reflect the dimensions of gear drives currently being offered. Request a Certified Dimension Print for construction use.

TABLE II - DIMENSIONS

Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	W	X	WEIGHT	
85	1 1/2"	10 1/2"	2 1/2"	2 1/2"	6	3.80	1.740	5	10	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	80
85	2 1/2"	14 1/2"	2 1/2"	2 1/2"	8	1.240	1.900	6	11	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	135
110	2 1/2"	17 1/2"	2 1/2"	2 1/2"	8	1.480	2.374	7	13 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	205
135	2 1/2"	21 1/2"	2 1/2"	2 1/2"	9	1.814	2.624	8	16 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	300
155	3 1/2"	25 1/2"	2 1/2"	2 1/2"	9	1.874	2.999	9 1/2"	19 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	475
175	3 1/2"	29 1/2"	2 1/2"	2 1/2"	9	1.874	2.999	9 1/2"	20 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	825

* Model 85 has a 10" Diameter Base

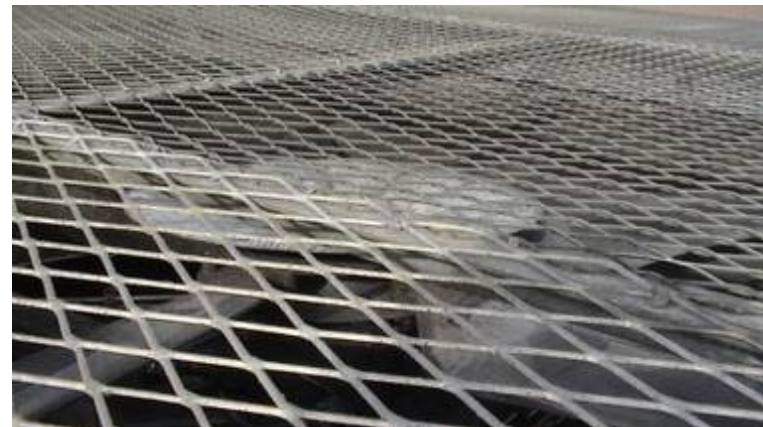
Clemson Cooling Tower

Fan Information (Both Units)

Manufacturer: Hudson Fans

Model: APT-18B-5

Diameter: 18' - 0"



Clemson Installation Test Data

	2-Speed, 326T Induction Motor	RPM AC, FL4493 PM Motor
Fan Load	41.5 Hp	41.5 Hp
Gearbox and couplings Efficiency	90.2%	N/A
Motor Horsepower	46.0 Hp	41.5 Hp
Motor Efficiency	90.0%*	93.1%
Drive	N/A	98.8%
Input kW	38.1	33.6
Total Efficiency	81.2%	92.0%

4.5 kW
Savings

- New motor is 93.6% efficient (existing motor is 22 years old)
- Gearbox manufacturer states gearbox efficiency at 96%
- Test data indicates mechanical system (gearbox, couplings, driveshaft) is 90.2%

Data verified by Clear Air Engineering on site at Clemson University

* Published Data

BALDOR

Clemson Installation Test Data

Loaded Noise Levels (A-weighted)		
Average	High Speed	Low Speed
Induction NEMA Motor Tower	82.3 dBA	74.4 dBA
<u>Laminated Frame</u> <u>IPM</u> Tower	77.7 dBA	69.0 dBA

Data verified by Clear Air Engineering on site at Clemson University

50 HP @ 207 RPM 1670 lbs.

BALDOR

Clemson Project Summary

- **Laminated Frame Interior PM motor technology enables direct drive gearless system**
 - Gearbox low speed lubrication issues are eliminated
 - No drive shaft
 - No couplings
 - No guards
 - No alignment
 - Minimizes blade load fluctuation
- **Motor can be configured to be drop in replacement for gearbox**
 - Clemson University Beta site was a drop in
 - Conversion at Clemson took under six hours
- **Improved Reliability and Maintainability**
 - Simplified System
 - Increased overall system efficiency
 - Elimination of gearbox provides biggest improvement in overall fan drive system efficiency
 - Direct motor reduces noise level of cooling tower
- **Although a Baldor V*S drive is required, the majority of cooling towers are being retrofitted with VFDs for overall cooling tower system efficiency improvement**



Direct Drive Savings and Comparison


- **Simplified installation and reduced maintenance are the major selling points**
 - No gear, line shaft, couplings guards, etc
- **Biggest gains in energy savings when system takes advantage of airflow**
 - Reduces the overall Motor HP requirements for the fan
 - 50-60% energy savings are typical
 - Applying drives on NEMA induction motors saves a similar amount of energy as with the Baldor PM direct drive motor solution
- **Old retrofits can show significant energy savings**
 - Both PM or Induction motor upgrades if the original gear and motors are lower efficiency
 - 10-15% energy savings are possible
- **Minimal energy savings if variable speed is not required**
 - Efficiency difference between Baldor IPM motor and newer efficient installation is minimal
 - 2% Plus or minus energy savings is the expectation
 - The primary reason is that the efficiency of the PM motors at the very low speeds of the fan is not very high, drive losses also have to be considered

BALDOR

Thank You



BALDOR



Optional Slides

VS1CTD Software

Ratings and Model Numbers

VS1CTD Operating Modes

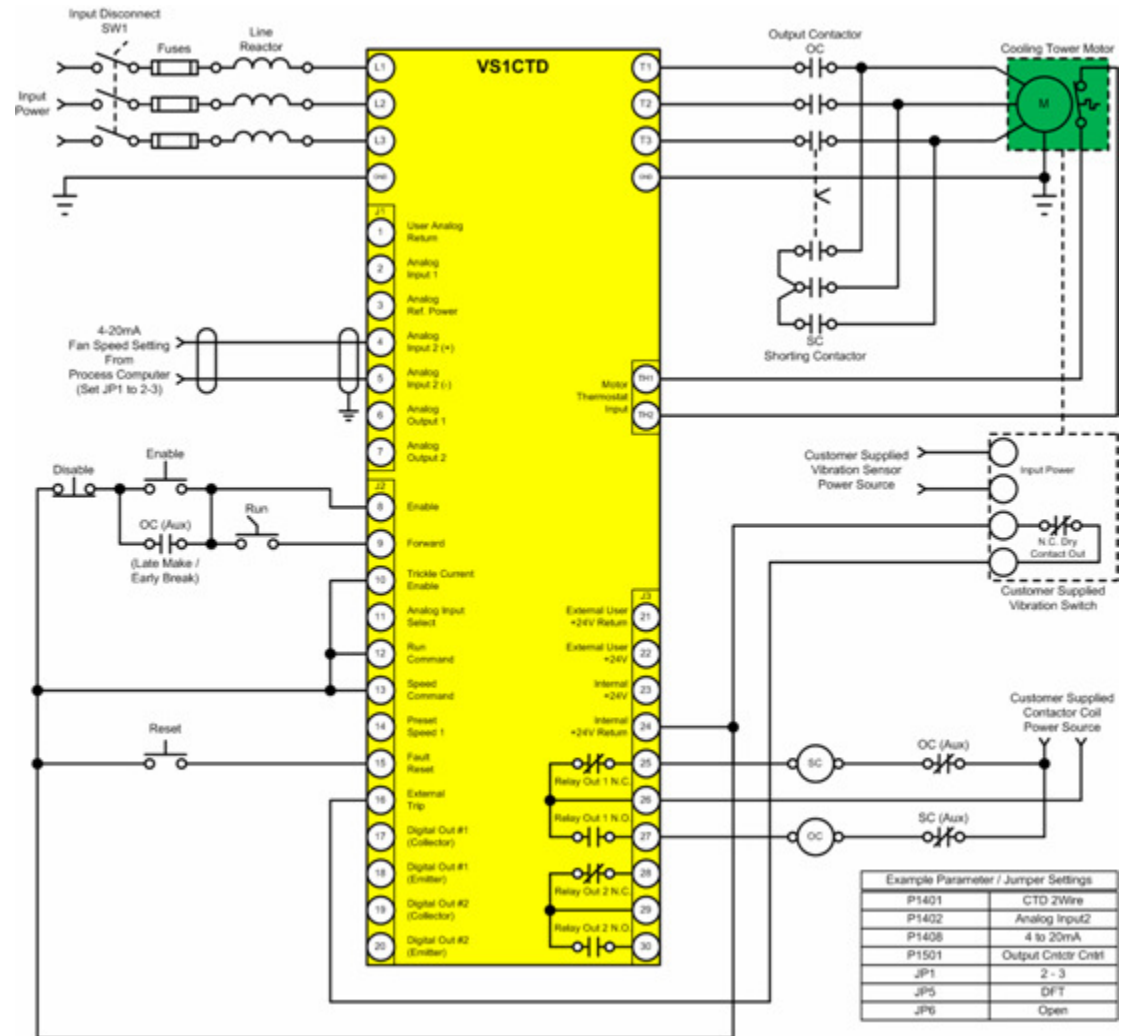
- The VS1CTD has been simplified with only five (5) operating modes
 - Keypad
 - Process Control
 - Network
 - CTD 2Wire
 - CTD 3 Wire



BALDOR

CTD 2Wire Operating Mode

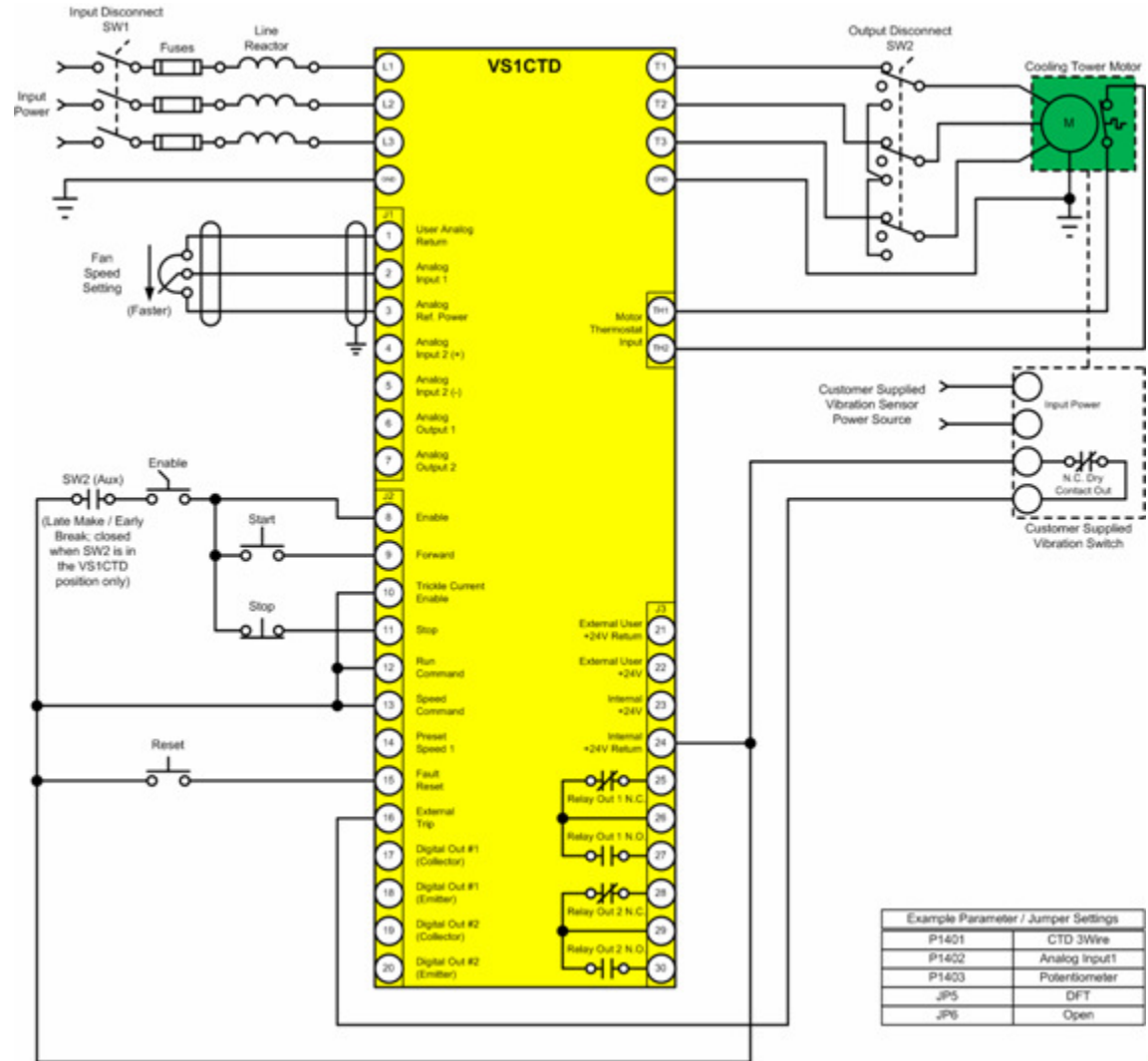
- Provides for 2-wire terminal strip control
- This example shows contactors on the output and 4-20mA speed control



BALDOR

CTD 3Wire Operating Mode

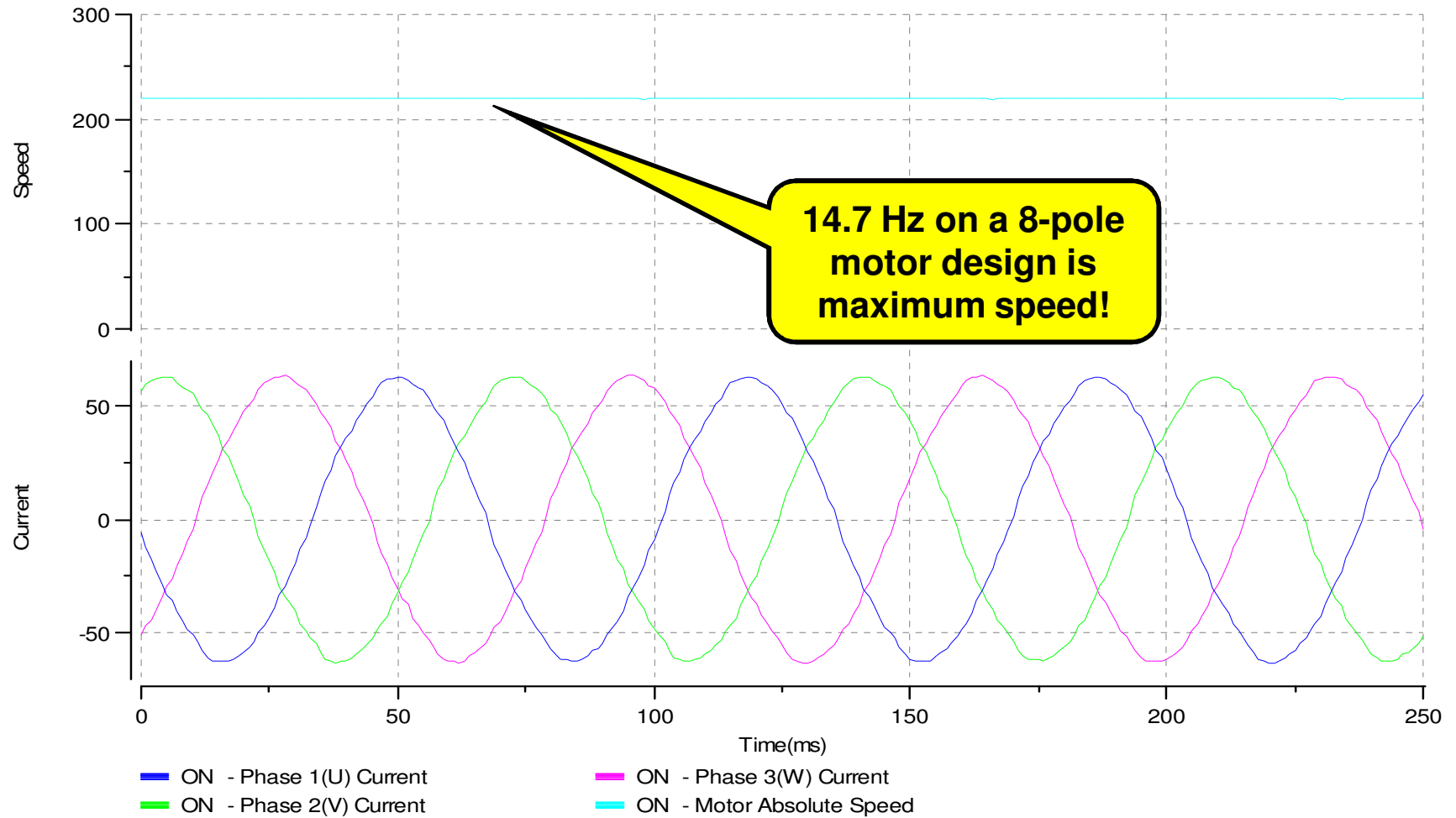
- Provides for 3-wire terminal strip control
- This example shows a 3-position disconnect on the output and potentiometer speed control



BALDOR

VS1CTD Smooth Control

Emory Tower 2 220RPM



BALDOR

VS1CTD Startup Sequence

- **Follow the “flow” of the User’s Guide**
 - Read and understand warnings and cautions
 - Verify installation
 - Rating of drive meets or exceeds FLA of motor
 - Environment is proper for enclosure and drive is mounted securely on vertical surface
 - Incoming power and motor leads in separate conduits with a ground wire pulled in each conduit
 - Motor thermal leads connected and run in separate conduit
 - Vibration switch connected and run in separate conduit
 - May need separate control power
 - Wires meet wire gauge specifications and are tightened properly per torque specifications
 - Drive chassis is solidly grounded
 - Control signals connected and run in separate conduits from power
 - Choose operating mode to determine connections
 - External device for drive enable (J2-8) required

BALDOR

VS1CTD Startup Sequence

- **Follow the “flow” of the User’s Guide (Continued)**
 - Make sure motor and fan are securely mounted and free to rotate
 - With enable circuit open (J2-8), apply incoming power
 - Drive powers up within “Basic Parameters” menu
 - Enter motor nameplate data
 - Execute “Calc Motor Model”
 - Select operating mode
 - Place drive in “Remote”
 - Run motor
 - Enable drive and then provide a run command
 - Motor will be energized at zero speed with an alignment current
 - Motor will rotate a partial revolution until magnets aligned under stator field
 - Drive locks in the magnet position
 - Drive starts ramping to set speed

Done!

BALDOR

VS1CTD Does Not Use Autotune!

- **Existing motor design**
 - Search firmware database
- **New motor design**
 - Use custom motor block
 - Parameters to be integrated into motor data sheet



BALDOR

VS1CTD Calc Motor Model

- **Calc Motor Model Requirements**
 - Enter motor design number for existing motor
 - If non-existent, prompted to use custom motor block
 - For new motor, enter data from motor electrical design into custom motor parameter block
 - Execute Calc Motor Model
 - Drive will not run until successful (fault occurs indicating this problem)

DESIGN	FRAME	IP	TYPE	PHASE	HERTZ	RPM
9949132.20	FL403	T5	IPM	3	15.0	150
VOLTS	AMPS	DUTY	AMPC	INHL	A.F.	ENCL.
480	86.5	CONT	40	0	1.00	TELO
MAX. SATE MECHANICAL SPEED-RPM	MOTOR PK (kW)	ORIG. BETWEEN LEADS	TYPICAL DATA			
2700	136.7	0.2720	ALL DATA BY FUNDAMENTAL COMPONENT DATA			
VARIABLE SPEED PERFORMANCE			MAXIMUM PERFORMANCE (CONTINUOUS RATED)			
HP	AMPS (RMS)	RPM	EFFICIENCY	POWER FACTOR	VELOCITY (RPM)	VELOCITY (RPM)
Open Circuit**	4.0	150	3	N/A	N/A	0.0
Open Circuit, Ind	4.0	150	3	N/A	N/A	0.0
54.00	21.8	150	20.2	98.9/98.9	320	0.0
34.00	45.2	150	36.0	94.3/94.2	300	0.0
54.00	44.9	150	41.0	91.7/91.8	425	0.0
75.00	86.5	150	44.0	89.7/91.6	400	0.0

¹ Gamma (γ) is the current angle relative to current and defined to be positive when current leads counter and Equivalently, Gamma is positive when it is negative.

² Data at 25 °C - all other data at rated temperature

Air Flow Velocity Requirement = 800 F/Min

PART NO.	QTY	HP	VOLTS	IP	PHASE	FLA	LRA
N/A	--	--	--	--	--	--	--

BALDOR MOTOR PERFORMANCE DATA
 DESIGNED BY: CK, DD, APP BY: C.M. Date: 01/15/2008
 A.C. MOTOR PERFORMANCE DATA: P54345A 001/01/2 000 000 0000



BALDOR

Cooling Tower Ratings

Cooling Tower - System

- **Motor and Drive Package (On Bus):**

CTPM4412522D4125 = Package Motor & Drive

CTPM4412522 = Motor CTPM4412522

D4125 = Drive VS1CTD4125-1B

Cooling Tower Package Ratings

RPM AC Cooling Tower Motor and Drive Specifications

Fan Reference Dia. (ft)	Fan Torque (lb ft)	Min. Required Air Velocity (ft/min)	Motor Base Speed (RPM)	Motor HP at Base Speed	Motor Frame Size	Motor & Drive Catalog No.	Motor Full Load Amps	Aprx. Motor Wt. (lb)	*Motor Height "M" (in.)	Drive Max Amps	Drive Frame
Air Cooled Units											
6	95	500	550	10	FL2554	CTPM2501050D410	11	375	14.87	11.9	AA
10	140		375	10	FL2562	CTPM2501032D410	11	440	16.87	11.9	AA
10	210		375	15	FL2570	CTPM2501535D415	14	515	18.87	23.0	B
10	263		300	15	FL2578	CTPM2502037D415	22	590	20.87	23.0	B
10	286	750	275	15	FL2873	CTPM2801527D415	23	610	18.87	23.0	B
12	382		275	20	FL2882	CTPM2802027D420	26	705	21.12	28.9	B
12	438		300	25	FL2890	CTPM2802530D425	24	790	23.12	34.0	B
12	630		250	30	FL4472	CTPM4403025D430	43	1154	17.59	44.2	C
12	700		300	40	FL4472	CTPM4404030D440	43	1154	17.59	55.3	C
10	808		325	50	FL4477	CTPM4405032D450	50	1290	18.84	65.5	D
14	1050		250	50	FL4485	CTPM4405025D450	59	1515	20.84	65.5	D
16	1313		200	50	FL4493	CTPM4405020D450	59	1730	22.84	65.5	D
18	1576		200	60	FL4402	CTPM4406020D460	71	1980	25.09	90.8	D
18	2101		150	60	FL4413	CTPM4406015D460	71	2290	27.84	90.8	D
18	2251		175	75	FL4421	CTPM4407517D475	76	2510	29.84	116.6	D
18	2626		200	100	FL4429	CTPM4410020D4100	94	2730	31.84	136.3	D
14	2918		225	125	FL4440	CTPM4412522D4125	129	3035	34.59	144.0	D



Cooling Tower Nomenclature - Motor

- **Motor Only 125HP, 225RPM, FL4440 (On Bus):**

CTPM4412522

CT = Cooling Tower

PM = Permanent Magnet Salient Pole Rotor

44 = 440 frame size (first two digits of frame)

125 = 125HP

22 = 225 RPM (first two digits of base speed)

BALDOR

RPMAC Cooling Tower Product Line

RPMAC Cooling Tower Product Matrix

8/17/2009

Current ratings FL250, FL280 and FL440, Future Ratings Available March 2010 FL5800

Speed															
500	FL2562	FL2562	FL2570	FL2578	FL2882	FL2890	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5815
475	FL2562	FL2562	FL2570	FL2578	FL2882	FL4472	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4421	FL4440	FL5817
450	FL2562	FL2570	FL2578	FL2873	FL2882	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4421	FL5815	FL5817
425	FL2562	FL2570	FL2578	FL2882	FL2882	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5815	FL5819
400	FL2562	FL2570	FL2578	FL2882	FL2890	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5817	FL5819
375	FL2562	FL2570	FL2578	FL2882	FL2890	FL4472	FL4477	FL4477	FL4485	FL4493	FL4413	FL4413	FL4440	FL5817	FL5822
350	FL2562	FL2578	FL2882	FL2882	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4421	FL4440	FL5819	FL5822
325	FL2570	FL2578	FL2882	FL2890	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5817	FL5819	FL5825
300	FL2570	FL2578	FL2882	FL2890	FL4472	FL4472	FL4485	FL4485	FL4493	FL4413	FL4421	FL4429	FL5817	FL5822	FL5825
275	FL2570	FL2873	FL2882	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4421	FL4440	FL5819	FL5822	FL5827
250	FL2570	FL2882	FL2890	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5815	FL5822	FL5825	FL5830
225	FL2570	FL2882	FL4472	FL4472	FL4477	FL4477	FL4493	FL4493	FL4413	FL4421	FL4440	FL5817	FL5822	FL5827	FL5832
200	FL2578	FL2890	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5817	FL5819	FL5825	FL5832	
175	FL2873	FL4472	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4421	FL4402	FL5819	FL5822	FL5830		
150	FL2882	FL4472	FL4477	FL4485	FL4485	FL4493	FL4413	FL4413	FL4429	FL5817	FL5822	FL5825	FL5832		
125	FL2890	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5815	FL5822	FL5825	FL5830			
100	FL4472	FL4477	FL4485	FL4493	FL4402	FL4413	FL4429	FL5815	FL5819	FL5825	FL5832				
HP	10	15	20	25	30	40	50	60	75	100	125	150	200	250	300

Note; For more compact designs the FL2873 can achieve any FL250 rating, FL4472 and achieve any FL280 rating and the FL5814 can achieve any FL440 rating.

FL5800 frame designations will need to be update to 2F*4 when available

All 250 & 280 frames are 4 pole and 440 frames are 8 pole designs.



Cooling Tower Nomenclature - Drive

- Drive Only 125HP (On Bus):

VS1CTD4125-1B

VS1 = VS1 Drive Platform

CT = Cooling Tower Family Series

D = Drive

125 = 125HP

4 = 460 volts

1 = NEMA 1 enclosure

B = Braking (both transistor and resistor)

See page D-1v of VS1 drives catalog for more detailed information

BALDOR

VS1CTD Ratings

Catalog Number	Input Volts	Frame Size	Normal Duty (Standard 4kHz PWM)				
			Input Amps	Output			
				HP	kW	IC*	IP*
VS1CTD47-1B	480	AA	11.9	7 ½	5.6	11.9	13.7
VS1CTD410-1B	480	AA	11.9	10	7.5	11.9	13.7
VS1CTD415-1B	480	B	23.0	15	11	23.0	26.4
VS1CTD420-1B	480	B	28.9	20	15	28.9	33.2
VS1CTD425-1B	480	B	34.0	25	18.7	34.0	39.1
VS1CTD430-1B	480	C	44.2	30	22.4	44.2	50.8
VS1CTD440-1B	480	C	55.3	40	30	55.3	63.5
VS1CTD450-1B	480	C	65.5	50	37	65.5	75.3
VS1CTD460-1B	480	D	90.8	60	45	90.8	104.4
VS1CTD475-1B	480	D	116.6	75	56	116.6	134.0
VS1CTD4100-1B	480	D	136.3	100	75	136.3	156.8
VS1CTD4125-1B	480	D	143.8	125	93	143.8	165.4
VS1CTD4150-1T	480	E	204.0	150	112	204.0	234.6

* The column labeled IC indicates the continuous output current rating of the control and the column labeled IP indicates the peak output current capability of the control for 1 minute.

BALDOR

Questions?



BALDOR