OPTIMAL FLUX

DRIVE AND MOTOR INNOVATION FROM WEG

For applications requiring greater than a 20:1 constant torque speed range using

WEG CFW09 Variable Frequency Drives coupled with WEG W21 Motors

What is OPTIMAL FLUX?

Combining a WEG Variable Frequency Drive (VFD) with a WEG Motor results in Optimal Flux. How? The design characteristics of a WEG motor are loaded into the WEG VFD. The Optimal Flux control algorithm increases motor flux slightly at low speeds, thereby allowing the same torque to be developed at lower current. The result is optimal motor flux at low speeds to produce full torque while minimizing motor losses.

Why OPTIMAL FLUX was developed

Historically, variable speed constant torque applications were driven by DC motors fed from DC variable speed drives. The DC motors were typically cooled by a separately driven blower, allowing full load operation to low speeds. However, design factors typically limited the speed range to 20:1.

In the 1990's, consumers migrated to AC motors powered from VFD's. However, AC powered applications were limited to variable torque applications due to cooling limitations on the available TEFC AC motors. The air flow (cooling) from the shaft mounted fan used on a TEFC motor is dramatically reduced as speed decreases. If the load were not also reduced as speed decreased, the reduced cooling would result in motor over-heating. Variable torque loads (centrifugal fans and pumps) require less torque as speed is decreased, making them ideally suited to the drive/motor combinations available at that time.

As VFD technology evolved, motor designs were modified to provide adequate cooling at low speeds. This was accomplished by upsizing TENV motors at low HP ratings and by fitting a separately driven blower in place of the shaft mounted fan resulting in TEBC designs vs TEFC. Many manufacturers refer to these TEBC designs as 1000:1 or 2000:1 designs. The reality - they are all thermally capable of full torque operation from zero to base speed. While these motors have advantages in certain applications, the end result was specialized designs, often NEMA type A. These NEMA type A's were not capable of direct on-line starting and were exempt from the efficiency requirements of EPACT.

The vast majority of industrial constant torque (CT) applications do not require continuous operation at full torque below 1/20th (5%) of base speed. While some larger and a select few special applications require full torque continuously at or near zero speed, these applications used DC motors fed from DC drives that were limited to 20:1 CT. Most applications have a smaller CT speed range.

WEG developed Optimal Flux to specifically address the needs of the broader constant torque AC VSD market. Specifically, those applications with +/-0.5% regulation without an encoder and a CT speed range greater than 10:1 (less than 100:1 is required). Optimal Flux allows the operation of certain WEG motors over speed ranges approaching 1000:1 without thermal damage (see chart on next page for performance/speed range data), absent closed loop feedback from a motor mounted encoder.

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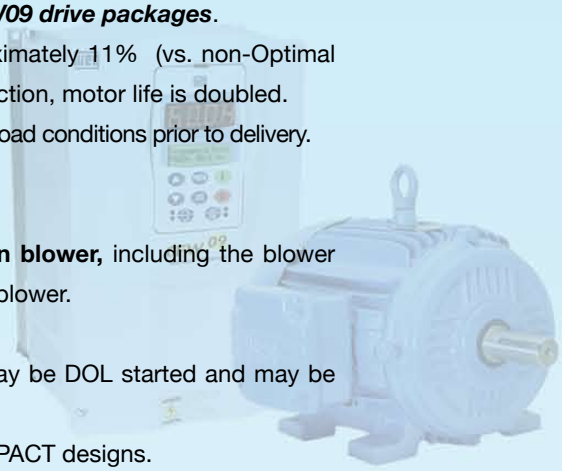
What are the advantages of OPTIMAL FLUX?



- **3 year extended warranty** on WEG W21 NEMA Premium motor & ***CFW09 drive packages***.
- **Doubled motor life as operating temperature is reduced** by approximately 11% (vs. non-Optimal Flux Control VFD). Typically, for each 10 degrees C of temperature reduction, motor life is doubled.
- **Elimination of incompatibility** as WEG tests the drive and motor under full load conditions prior to delivery.
- **Single source customer support** for motor and drive.
- **Less down time** resulting in cost savings.
- **Elimination of costs associated with operating a separately driven blower,** including the blower starter, additional cable run to the motor and the energy to operate the blower.
- **Elimination of Output reactor** for motor cable runs to 100M.
- **Reduced spare inventory** when using NEMA Type B motor. Motor may be DOL started and may be used in most applications in the plant.
- **Reduction in energy use** for NEMA Premium Efficient motor vs. non-EPACT designs.
- **Save money** through lower purchase cost of W21 motor vs. "special" VFD designs.

How does OPTIMAL FLUX achieve lower motor losses?

Most of the heat in motors is the result I^2t losses. If motor current can be reduced even slightly, the resultant losses are noticeably reduced. Variable torque loads inherently accomplish this since they require less torque (less current) as their speed is reduced. Constant torque loads may require full torque at low speeds. Merely reducing the current would reduce both losses and torque which would be unacceptable. The design characteristics of WEG W21 motor are loaded into the CFW09 VFD which allows the Optimal Flux Control algorithm to increase motor flux slightly at low speeds thereby allowing the same torque to be developed at lower current. The result: The VFD can optimize motor flux at low speeds to produce full torque while at the same time minimizing motor losses.

Speed Range (Regulation)

	V/Hz **	Vector	
		Sensorless	w/ Encoder **
Speed range	1:20 (90 rpm to 1800 rpm)*	1:100 (18 rpm to 1800 rpm)*	Down to 0 rpm
Speed regulation *	+/- 1%	0.05%	0.01%
Starting torque	100%	150%	150%

* % of base speed
** Optimal Flux Control not possible in V/Hz or closed loop vector modes.
Note: Speed Regulation may not be adequate for some applications. (TEBC only)

Standard Drive Vs. CFW09 with Optimal Flux

W21 HIGH EFFICIENCY TEFC MOTORS					
Frame Size	Constant Torque	Variable Torque	Constant Horsepower	Drive	Comments
143-505	100 : 1	1000 : 1	60-90 Hz	WEG (*)	Optimized (V/f)
143-505	12 : 1	1000 : 1	60-90 Hz	Any	Constant (V/f)

W21 NEMA PREMIUM EFFICIENCY TEFC MOTORS					
Frame Size	Constant Torque	Variable Torque	Constant Power	Drive	Comments
143-505	1000 : 1	1000 : 1	60-90 Hz	WEG (*)	Optimized (V/f)
143-505	20 : 1	1000 : 1	60-90 Hz	Any	Constant (V/f)

* CFW09

W21 NEMA HIGH EFFICIENCY motors may be operated in sensorless vector mode over a 100:1 speed range with +/-0.5% regulation *while staying within the thermal limits of the motor.*

W21 NEMA PREMIUM EFFICIENCY motors may be operated in sensorless vector mode over a 100:1 speed range with +/-0.5% regulation *while operating even cooler than the NEMA High Efficiency motors because these motors have a 1000:1 CT speed range (thermal).*

More information available in these WEG publications:

This is WEG

CFW09 Sales Brief

Automation Product Guide

Eight Great Reasons

Stock Products Catalog

Automation Selection Guide

WEG Electric Motors Corp.
1327 Northbrook Parkway, Suite 490
Suwanee, GA 30024

www.wegelectric.com
1-800-ASK-4WEG (275-4934)

Contact your local WEG distributor today:

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