Dynamatic®
DRIVE SOURCE INTERNATIONAL, INC.
1-800-548-2169 www.dynamatic.com
World's leading manufacturer of Eddy Current drives, brakes and controls

7900 Durand Avenue, Bldg. 3
Sturtevant, Wisconsin, U.S.A. 53177
Tel: 262-554-7977 Fax: 262-554-7041
Toll Free: 1-800-548-2169
E-Mail: sales@dynamatic.com

October 30, 2018

Ms. Sue McCormick, Chief Executive Officer
Mr. Freman Hendrix, Board Chairman
Mr. Navid Mehram, COO Wastewater Operating Services
Great Lakes Water Authority
735 Randolph Street, Suite 1800
Detroit, MI 48226

Subject: Alternate AC Motor Speed Control
Reference: Long-Term Reliability, Less Maintenance & Electrical Energy Costs

Greetings,

The purpose of this letter is to ask you to consider the alternate solution of using Eddy Current AC motor speed control drives in place of the popular and frequently specified variable frequency drives. Why?

- For decades before variable frequency drives came onto the scene in the 1980's, Eddy Current Drives provided excellent AC motor speed control with little maintenance.
- When bill of materials of Eddy Current Drives are compared to Variable Frequency Drives there are fewer parts that can go bad with Eddy Current Drives.
- Since variable frequency drives have become popular in wastewater treatment plants applications, many attending trade shows provide comments that they are experiencing more maintenance and replacement costs than was initially anticipated.
- Eddy Current Drives save electrical energy from 85% to 99% of rated motor speed whereas variable frequency drives do not.

The following statement comes from Geoffrey Stone, a professional mechanical engineer and his Internet article called Pump Applications Using VFD's; Are VFD's worth it for pump applications? Have they been oversold to the market?

"The statistical evidence in the UK and in the US that the primary cost of a pump is approximately 12-15% of its whole life costs. The remainder goes in maintenance and energy costs. The energy costs are the largest proportion. Variable frequency drives do not save energy in many cases. In fact they consume more energy than other solutions. All analysis should be on the basis of wire to water, for example, the kilowatts to move x amount of cubic meters of fluid."

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Another professional is Dr. William C. Livoti, PSAP who on January 31, 2019 will provide a one hour webinar called "The Evolution of Variable Speed Drives in the Pump Industry through Pumps and Systems Magazine. PSAP is the abbreviation for Pump Systems Assessment Professional that is issued by the Hydraulic Institute. This program sets the standard for the discipline of pump systems assessment and the use of pump system optimization techniques. Certification will provide a high level of confidence to end-users and other stakeholders that pump system assessors have the experience and expertise to perform high quality assessments which will lead to more energy efficient and reliable pumping systems.

Dr. Livoti stresses focusing upon the system solution, not on individual components as many unfortunately do. Over-sizing pumps and selecting components with higher efficiencies is not a true measure getting a better bottom line result that many are striving to obtain. He is someone who has several years of experience in this industry. This project needs to focus on reliable pumping systems and one component that will help obtain this goal would be Eddy Current Drive Control. Eddy Current Drives have many years of outstanding performance even if many consider this "old technology." Sometime being old is not bad.

We would like your consideration, approval and to supply Eddy Current Drives in your JOC method for all applications where long-term reliability of AC motor speed control is planned and where less maintenance and electrical energy costs are desired.

Sincerely yours,

Jonathan S. Johns, BSEE
Sales Engineer
Drive Source International
7900 Durand Ave., Building 3
Sturtevant, WI 53177

Electrical Power Consumed for 500 HP Motor Rated at 880 RPM at 4 Different Pump Speeds:

Consideration:	**75% of Motor Speed:**	**85% of Motor Speed:**	**95% of Motor Speed:**	**99% of Motor Speed:**
Variable Frequency Drive	250 KW	350 KW	470 KW	520 KW
Eddy Current Drive	270 KW	340 KW	420 KW	450 KW
Energy Savings with Eddy Current Drive	No savings	10 KW	50 KW	70 KW

Since most wastewater pumping applications require 75-100% of rated motor speed, the eddy current drive uses less electrical energy from 85% to 99% of rated motor speed. Consider the annual electrical energy savings operating at 85%, 95% and 99% of rated motor speed for 12 hours/day, 365 days/year at $0.08/KWH:

For 85% of motor speed:
E_S = Annual energy savings
E_S = (350 KW – 340 KW)(12 hours/day)(365 days/year)($0.08/KWH)
E_S = $3,504/year

For 95% of motor speed:
E_S = Annual energy savings
E_S = (470 KW – 420 KW)(12 hours/day)(365 days/year)($0.08/KWH)
E_S = $17,520/year

For 99% of motor speed:
E_S = Annual energy savings
E_S = (520 KW – 450 KW)(12 hours/day)(365 days/year)($0.08/KWH)
E_S = $24,528/year

The electrical energy cost savings are for one pump motor.

Lifetime Ownership:

Consideration:	**Variable Frequency Drives**	**Eddy Current Drives**
Harmonic noise, radio frequency interference	Extensive	None
Long-Term cost of operation	Can be extensive	Minimal
Line voltage sensitivity	Extensive	Minimal
Heat & cold sensitivity	Extensive	Minimal
Upgradable to new components	Limited	Available
Cost of replacement parts	Can be high, if available	Low
Replacement parts availability	Limited, if at all after 5-8 years	Excellent: 40+ year manufacturing period
Service and repairs	Complex (by factory personnel)	Simple (by customer)
Inter-brand support	NO	YES
Downtime if problems with electronics	Can be weeks or months	Minutes (simple component swap-out)

Overall Pump System Operating Efficiency:

Consideration:	**Variable Frequency Drives:**	**Eddy Current Drives:**
Long-Term Reliability	Typically 3-5 year manufacturing run, planned obsolescence	20-40 year average life of mechanical components, 15-20 year controls life
Optimum efficiency at 75-100% operating motor speed	NO	YES
Ancillary equipment energy consumption	YES	NO

Dynamatic®
DRIVE SOURCE INTERNATIONAL, INC.

Case Study: TRUE System Efficiency

Why This Municipality Chose Dynamatic® over VFDs

Location: St. Joseph, Missouri, Water Protection

Background: Dynamatic® drive clutches on induction motors have been installed in wastewater treatment applications for many decades, primarily due to the inherent durability, simplicity, and reliability of eddy-current technology. Variable frequency drives (VFDs) gained popularity in the 1980s (see page two for a technical comparison). Real worlds experience at St. Joseph Water Protection provides fact-based results comparing the advantages and disadvantages of each pump drive system.

Challenges: The St. Joseph system receives power from a generating station on the Missouri River, and line output experiences occasional fluctuations. The operating environment can be harsh, with wide temperature and air quality variations.

Results: 15 VFDs were installed in 1979, during a system expansion, to complement existing eddy-current drives. Over the ensuing three decades, all of the VFDs have been replaced multiple times at a cost of several million dollars. Maintenance and replacement costs on the VFDs have been high. Long term reliability and factory support have been inferior. All original eddy-current drives, installed in the sixties, continue to be operational. Annual maintenance costs for the eddy-current drives are very low. The city of St. Joseph is replacing their VFDs with Dynamatic® eddy-current drives, and all new variable speed applications will specify Dynamatic® drives.

Don Gilpin, Superintendent of Wastewater Treatment

User Comments:

"We currently have six eddy-current drives that have been running nonstop since 1965. We have never lost one. I've lost so many VFDs over the past 30 years that it's not even funny"

"We had a situation multiple 300 horsepower VFDs that were only a year and a half old went Poof!, and we had to explain to the Missouri Department of Natural Resources why we were bypassing wastewater treatment for a week. The VFD maker didn't address over-voltage issues, even small ones, with a fail-safe. Eddy-current drives don't have any of those problems, as there are no high voltage electronics in front of the motors.

"We've done an annual cost and reliability evaluation of our different pump and air handling drives. The cost of maintaining our existing eddy-current drives is ridiculously low, like $40 a year for brushes. Once every two to three years, we soapstone clean the contacts, and that's it. We've spent millions on replacing VFDs, however.

"Although VFDs are known to be more efficient at speeds less than 75%, eddy-current drives are as good or better at normal operating speeds. If a system is sized correctly, its pumps should be operating speeds. If a system is sized correctly, its pump should be operating above 80% anyway. I've had extensive conversations with engineering firms about efficiency and proper system design. I've come to the conclusion that VFDs sounded like a great idea when they came out 30 years ago, but now, after decades of operation and experience here, we're realizing that their main selling point- efficiency- doesn't reflect reality."

Dynamatic® Drives: How they work

A VFD uses AC-to-DC voltage conversion, high-frequency sampling, and a powerful inverter in a large electronics rack to alter the speed of and to supply the operating voltage to an AC motor. A Dynamatic® drive uses eddy-current technology consisting simply of a constant speed AC induction motor and a magnetic clutch speed driven by a small analog or digital controller. The clutch uses an eddy-current coupling to vary the speed of an attached output shaft. DC voltage applied to a field coil in the clutch produces a magnetic field, which generates an attracting force to the inside of a hollow iron drum. The amount of power available is determined by the size of the motor, which can range from relatively small to motor, 4000 HP or more.

Efficiency Considerations:

At maximum clutch coupling, the total efficiency for Dynamatic® drives is just below that of the motor alone. A Dynamatic® drive's control unit supplies voltage to the clutch's coil and only requires 2% or less of the drive's total power. As the process speed reduces, the losses in an eddy-current clutch rise in proportion to the slip relative to VFDs, this creates an efficiency crossover point between 75% and 80% of motor base speed. Above this crossover point, the Dynamatic® drive is more efficient. Below this point, the VFD makes up for its initially higher control losses and becomes the better efficiency choice.

Dynamatic® Drive advantages:

Dynamatic® drives have an inherent long-term reliability advantage and function well in both adverse operating conditions and remote locations. Cooling, power management, and maintenance are minor and include only those service processes required for stand-alone AC induction motors. For systems that operate at 75 to 80% of base speed or higher a majority of the time, better efficiency is also a benefit.

Parts interchangeability and the availability and ease of replacements and upgrades make Dynamatic® drives a great long-term investment. Maintenance costs are low and can be completed by facility staff.

For more information, visit www.dynamatic.com

800-548-2169 (US/Canada) or 262-554-7977 (Outside US/Canada)

Up to 65% lower capital pump-drive system costs

Considerations:	Variable Frequency Drives	Dynamatic® Drives
Total cost of installation	Varies widely by operating environment and space requirements; can be extensive	Up to 65% lower than VFDs in 4160VAC and 2300VAC installa- ; comparable primary equipment costs in 480VAC and 575VAC installations
Cooling/air conditioning	Often required	None required
Power regulation	Recommended	None required
Electronic footprint	Very large	Small

Higher overall system operating efficiency

Considerations:	Variable Frequency Drives	Dynamatic® Drives
Long-term reliability	3-5 year manufacturing run, planned obsolescence	20-40 year average life of mechanical components, 15-20 year control life
Optimum efficiency at 75-100% operating speed	NO	YES
Ancillary equipment energy usage	YES	NO

Lowest lifetime cost of ownership

Considerations:	Variable Frequency Drives	Dynamatic® Drives
Harmonic noise / RF interference	Extensive	None
Long-term cost of operation	Can be extensive	Minimal
Line voltage sensitivity	Extensive	Minimal
Heat / cold sensitivity	Extensive	Minimal
Upgradable to new components	Limited	Available
Cost of replacement parts	Can be high, if available	Low
Replacement parts availability	Limited, if at all after 5-8 years	Excellent: 40+ year manufacturing period
Service and repair	Complex (by factory personnel)	Simple (by customer)
Inter-brand support	NO	YES
Downtime if problems with electronics	Can be weeks or months	Minutes (simple component swap-out)

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Application-engineered Systems: Drives, Brakes and Controls

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Dynamatic® provides TRUE system efficiency

"True efficiency" is defined by three important cost factors:

1 Capital Costs – up to 65% less than VFD systems

Consider all the costs associated with a pump-drive system

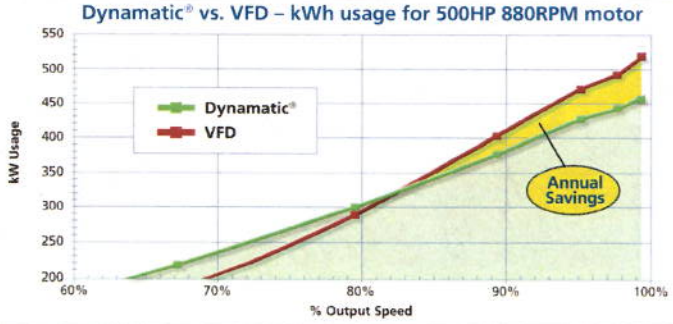
Considerations:	Variable Frequency Drives	Dynamatic® Drives
Total cost of installation	Varies widely by operating environment and space requirements; can be extensive	Up to 65% lower than VFDs in 4160VAC and 2300VAC installations; comparable primary equipment costs in 480VAC and 575VAC installations
Cooling/air conditioning	Often required	None required
Power regulation	Recommended	None required
Electronic footprint	Very large	Small

2 Energy Costs – lowest for wastewater pumping applications

Consider all the benefits of higher overall system operating efficiency

Considerations:	Variable Frequency Drives	Dynamatic® Drives
Long-term reliability	3-5 year manufacturing run, planned obsolescence	20-40 year average life of mechanical components; 15-20 year control life
Optimum efficiency at 75-100% operating speed	NO	YES
Ancillary equipment energy usage	YES	NO

Dynamatic® vs. VFD – kWh usage for 500HP 880RPM motor



Formula: Savings = kW difference x hrs x kW hour rate

Example @ 90% output speed,12 hours per day, $.08 per kWh:
Efficiency difference = VFD kW – Dynamatic kW = 410 – 390 = 20 kW
Dynamatic yearly savings = 4380 hrs x .08 x 20kWh = $7008

Dynamatic electromagnetic drive efficiency is ideally suited to wastewater pumping applications, which typically require from 75% to 100% motor speed regulation to move water. When operating efficiency is factored along with medium voltage first costs and lifetime ownership costs, total savings are often dramatic compared to variable frequency drive installations.

3 Ownership Costs – greatly reduced maintenance, repairs and upgrades

Consider the costs over the lifetime of ownership

Considerations:	Variable Frequency Drives	Dynamatic® Drives
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Did you know?

According to a nationwide survey* of water & wastewater industry professionals:

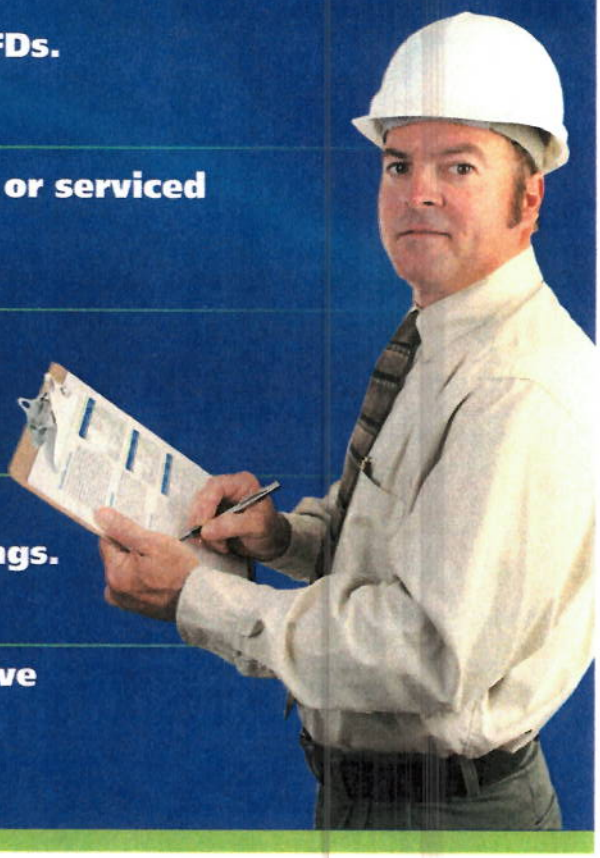
68% have had issues with VFDs.

70% have replaced, repaired or serviced VFDs in the last 2 yrs.

42% said these VFDs were UNDER 5 years old.

32% disputed manufacturer claims of VFD cost savings.

50% are open to an alternative to VFDs.



* Source: Survey of Water & Wastewater Industry Professionals on Variable Frequency Drive Performance and Longevity © 2012 Centrifuge Research

Stop sinking more and more money into VFDs...

Dynamatic® is your proven alternative!

- Lower capital costs, energy costs, lifetime costs
- Ruggedly built to outperform & outlast VFDs
- Over 50 years of proven performance

Outlast VFDs by as much as 6:1

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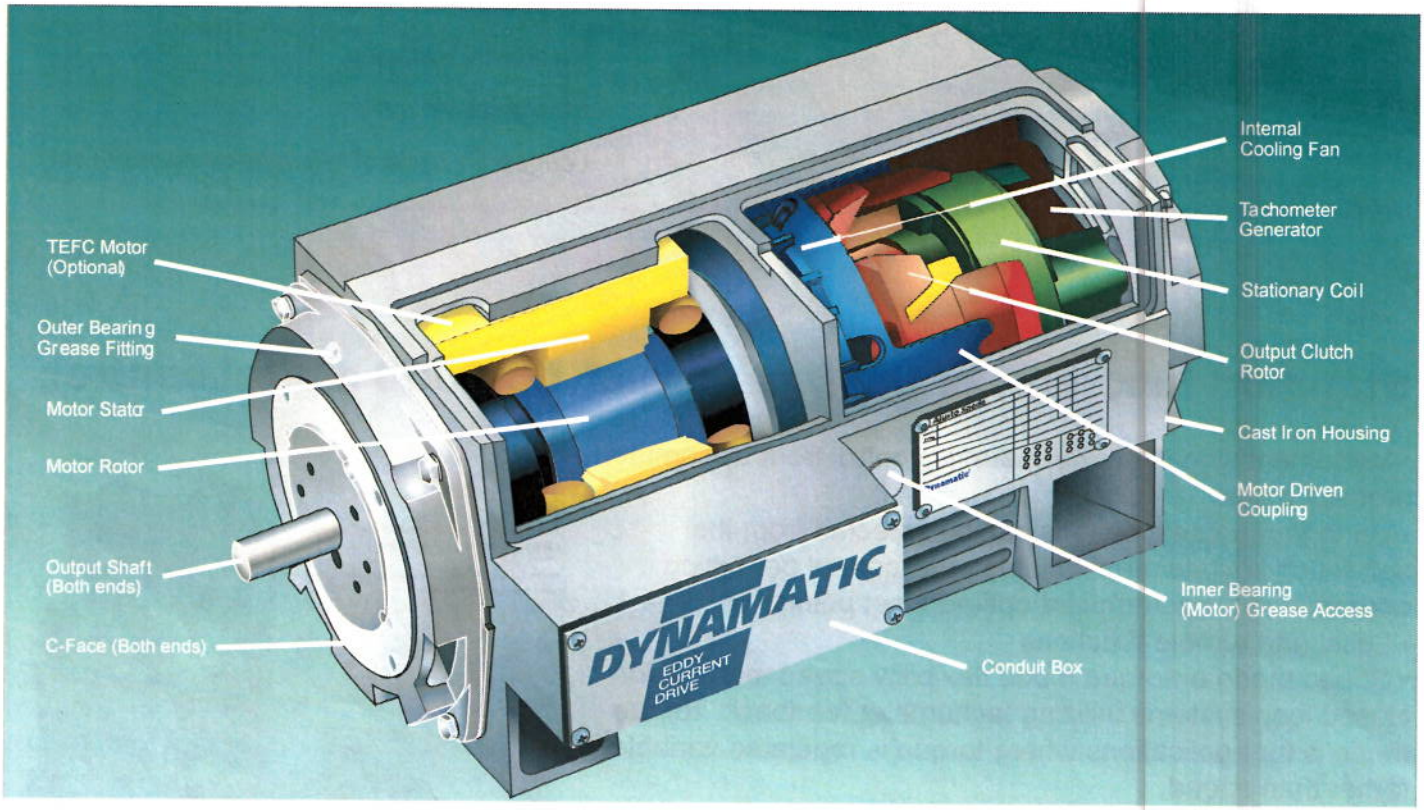
EDDY CURRENT DRIVE MODEL "AS"

HIGH PERFORMANCE TO MEET PRECISE DEMANDS

Dynamatic® "AS" Drive

Dynamatic® AS Eddy Current drives offer .75 to 40 horsepower, brush less design, cast iron housing, and separate, compact solid state controller with all functions on one printed circuit board.

- PLC Compatible
- Designed For Reliable Performance
- Built Tough
- Easy To Install
- Virtually No Maintenance Costs
- A Small, Simple Controller
- Low Life-Cycle Cost



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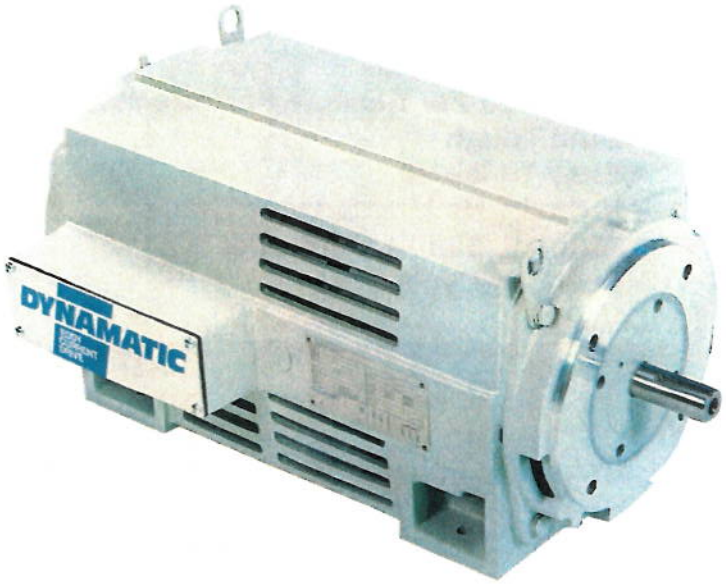
Compare your technology options, Dynamatic wins every time:

	Dynamatic® Drives	Variable Frequency Drives	Direct Current Drives
Speed range	34:1 typical	25:1 using standard motor	3:1, 25:1 typical
Starting torque	250%	100% to 150%	150%
Speed regulation	+–0.5%	3% typical, 0.5% available	1-3% standard, 0.5% available
Service/repairs	Infrequent / simple / low cost	Infrequent / complex / $$$$$	Infrequent / complex / $$$$$
Voltage protection	Least affected by transient conditions	Limited range of transient operation	Limited range of line input voltage
Controller	Simple, low power, single PCB	Complex, multiple PCBs	Complex with high power usage

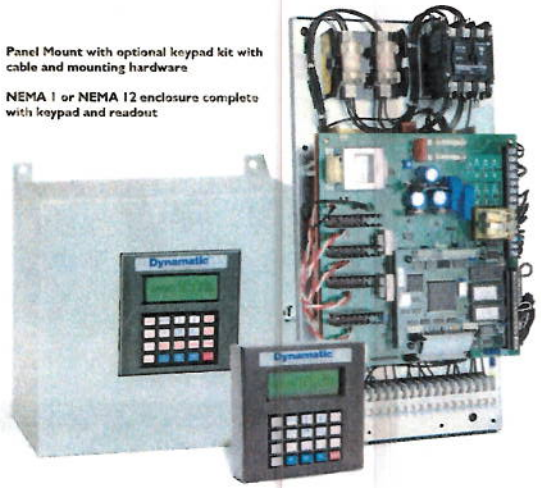


Dynamatic® AS Press Drives

- .75 to 40 HP.
- Brushless design and cast iron housing.
- No harmonic distortion.
- No power line problems.
- No nuisance tripping.
- No expensive spares.
- Longest life cycle of any variable speed drive.

Standard functions of the Dynamatic® EC 2000 digital control:

• Instrument signal follower permits control from all common process inputs
• Up to four presets speeds can be selected from the soft-touch keypad terminal strip or IP control permitting operation at predetermined optimum set points
• Local and remote functions
• Speed mode or torque mode flexibility speed mode is for closed loop systems utilizing tachometer feedback. Torque mode is for applications where torque is regulated variable rather than speed.
• Fully capable of using input terminals for analog equipment



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