LAPP ASIA PACIFIC WEBINAR 2021
DRIVING FORWARD WITH VFDS: A ROADMAP TO THE FUTURE

LAPP

THE SPEAKER

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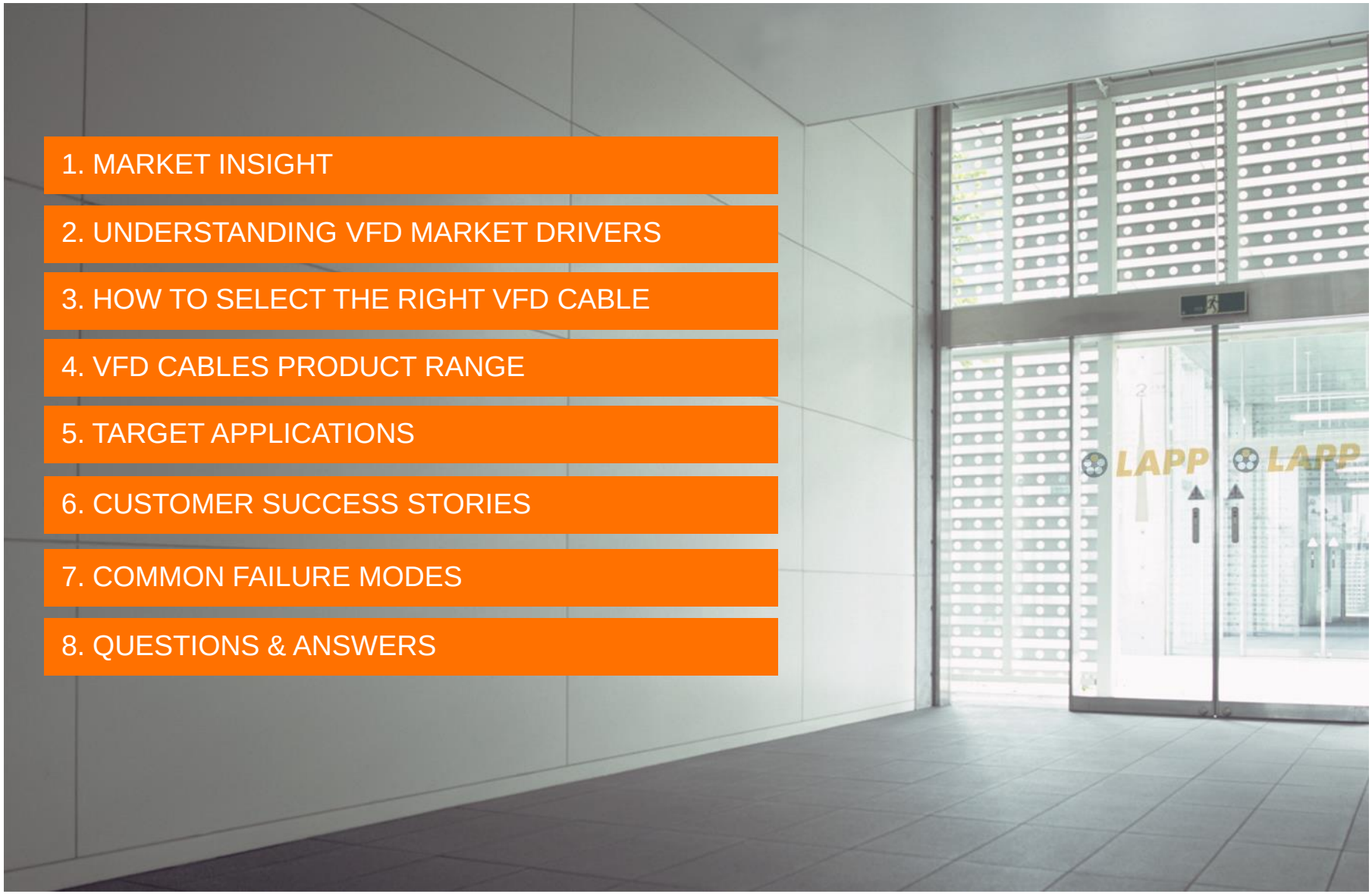
1. MARKET INSIGHT
2. UNDERSTANDING VFD MARKET DRIVERS
3. HOW TO SELECT THE RIGHT VFD CABLE
4. VFD CABLES PRODUCT RANGE
5. TARGET APPLICATIONS
6. CUSTOMER SUCCESS STORIES
7. COMMON FAILURE MODES
8. QUESTIONS & ANSWERS
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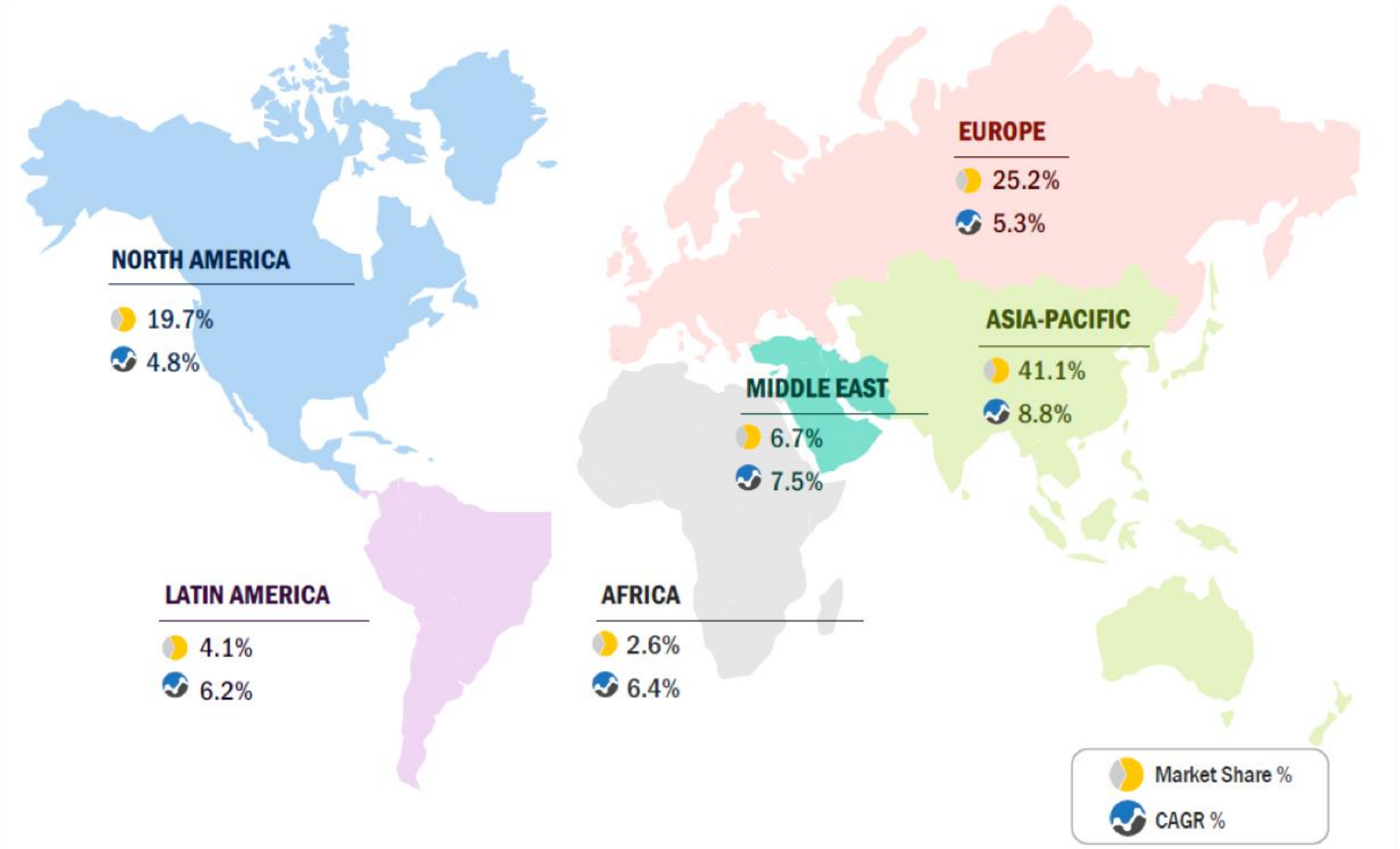
MARKET INSIGHT

ASIA PACIFIC HAD OCCUPIED LARGEST MARKET SHARE OF VFD INSTALLATIONS

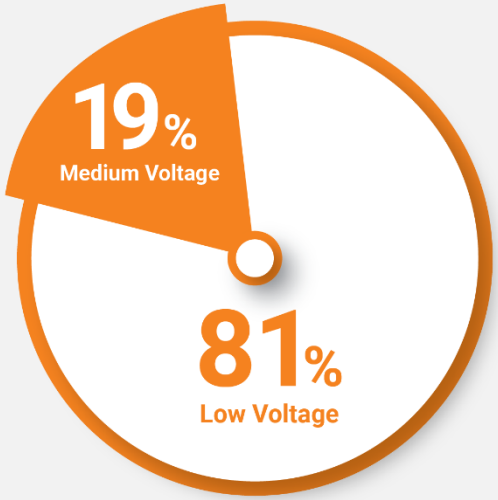


Reference: M&M VFD Market global forecast 2016-2021 report, 2015 figures

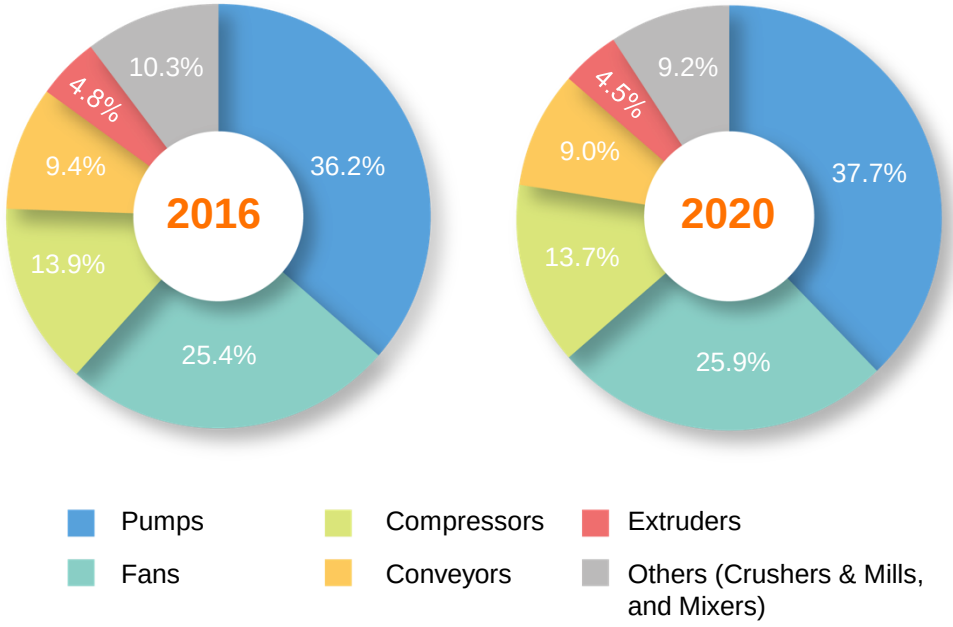
CAGR: % from 2016-2021

VFD APPLICATIONS HIGHLIGHT THE IMPORTANCE IT PROVIDES TO THE INDUSTRY

VARIABLE FREQUENCY DRIVES MARKET SHARE (VALUE), BY VOLTAGE, 2015



PUMPS SEGMENT IS ESTIMATED TO BE THE LARGEST APPLICATION IN 2016 & IS PROJECTED TO REMAIN SO BY 2020



Reference: M&M VFD Market global forecast 2016-2021 report

THESE ARE THE KEY FINDINGS OF VFD SUSTAINABLE GROWTH ON A GLOBAL BASIS

Increasing urbanization and industrialization

Photo Source: Unsplash

Industrial automation, building automation and water/wastewater being key sectors

Photo Source: Siemens

VFDs are very advanced technology devices

Photo Source: Parker

Reference: M&M VFD Market global forecast 2016-2021 report

6 MARKET LEADERS IN THE VARIABLE FREQUENCY DRIVE SEGMENT TAKE MORE THAN 60% OF GLOBAL MARKET SHARE

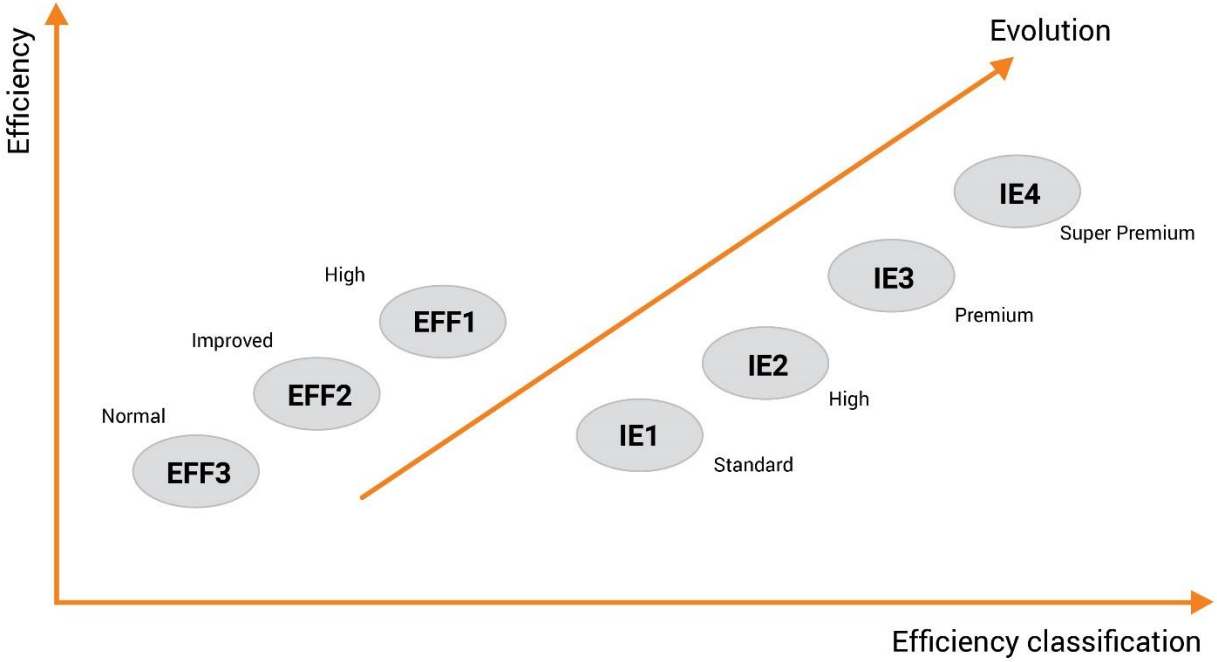
Reference: M&M VFD Market global forecast 2015-2021 report

Low Voltage Motor Market Overview allows VFD to grow at a sustainable pace

Think of the following:

- Electricity that an industrial LV motor will consume
- A lifespan of a LV motor
- Efficiency gain vs. electricity savings
- How will the VFD help the LV motor to achieve the above

Efficiency Class Comparison



Reference: 2015_IHS_Industrial Motors & Drives_Global Market Update

HOW TO CHOOSE THE RIGHT VFD CABLE

Maintaining control over motor **speed, torque** and **synchronization** ensuring **optimum output** and **increased efficiency**

Which benefits are offered using VFD?

- Energy savings
- Process optimization
- Smooth machine operation

What makes a cable a good VFD cable?

- Appropriate stranding
- Sturdy insulation
- Proper shielding
- Industrial hardening
- Ample grounding configuration and termination

These are the important attributes that allows the right selection of a VFD cable

LAPP offers VFD cable range designed to minimize EMC/downtime, saving you time, money and increasing machine efficiency

- GROUNDING
- HIGH QUALITY INSULATION
- FINE CONDUCTOR STRANDING

These are the reasons why customers choose LAPP

Works
with well-known VFD manufacturers

Complies
with all applicable regulatory and safety standards

> 50 years
of cable manufacturing experience & specialize in industrial segment

Wide range of VFD products

VFD CABLE PRODUCT RANGE

Choose the right VFD cable from our extensive offer

ÖLFLEX® Variable Frequency Drive Cables

ÖLFLEX® VFD 2XL
Both 600V and 2000V UL TC-ER rating. Extended performance with an XLPE (plus) insulation and a phthalate-free jacket.

ÖLFLEX® VFD 2XL with Signal
Based on ÖLFLEX® VFD 2XL with pair for brake or temperature (also 600/2000V).

ÖLFLEX® VFD SLIM
Reduced-diameter VFD cable. Semiconductive insulation layer to withstand nonlinear power distortions associated with VFDs.

ÖLFLEX® VFD with Signal
Based on ÖLFLEX® VFD SLIM with pair for brake or temperature.

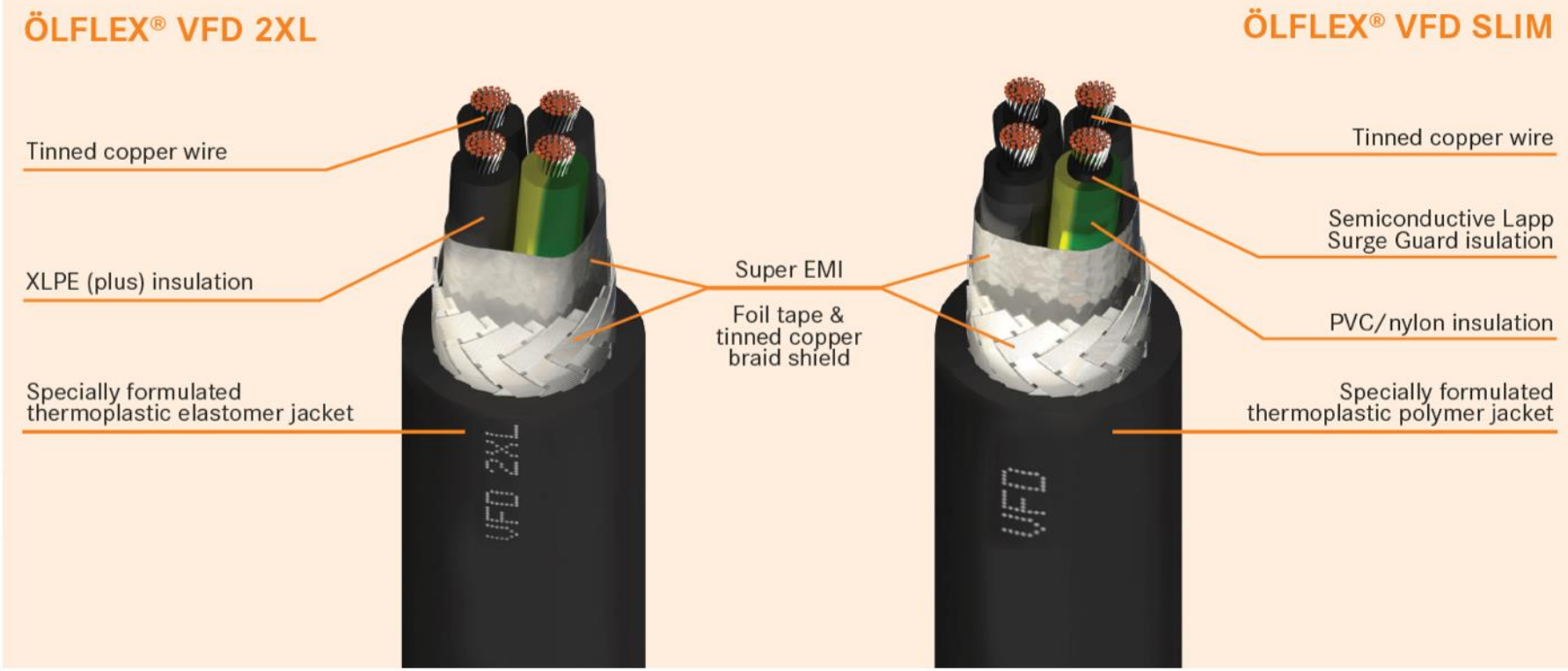
V 2000
Large-gauge VFD 2000V cable with three symmetrical grounds and a helical copper tape shield.

ÖLFLEX® FD VFD
Continuous flex VFD cable for moderate track applications.

ÖLFLEX® SERVO 9YSLCY-JB
Flexible large-gauge VFD cable. UL AWM rated, low-capacitance design, EMC-optimized. Available with either one or three symmetrical grounds.

ÖLFLEX® SERVO 2YSLCY-JB
Flexible large-gauge VFD cable. Low-capacitance design, EMC-optimized. Available with either one or three symmetrical grounds.

ÖLFLEX® VFD 2XL & ÖLFLEX® VFD SLIM



Exploded view of ÖLFLEX® VFD 2XL and ÖLFLEX® VFD SLIM cables. ÖLFLEX® VFD 2XL is a reduced-diameter cable, which provides three different voltage ratings (600, 1000 and 2000V).

ÖLFLEX® VFD with Signal

Description

- ÖLFLEX® VFD with Signal is an extremely oil- and UV-resistant shielded motor power cable for VFD drives**, with an additional pair for brake or temperature sensor.**
- It is designed with Lapp Surge Guard insulation, which includes a semi-conductive layer made to withstand nonlinear power distortions associated with VFD drives and to disperse increases in voltage

Application

- VFD drive and motor connections with temperature sensors or brake mechanisms
- Web presses
- HVAC
- On/off, slow down/speed up applications

USPs

- Lapp Surge Guard insulation system
- UL TC-ER & c(UL) CIC TC approved
- Double-shielded for extra protection
- Contains pair for brake or temperature sensor

V 2000

Description

- V 2000 is a **large AWG VFD 2KV cable designed with 3 symmetrical grounds** and a helical copper tape shield. It is UL Type TC-ER approved.

Application

- VFD drive and motor connections for large HP applications
- HVAC
- Large presses
- Any on/off applications using a VFD drive and motor

USPs

- 100% copper tape shield for EMI & RFI protection
- UL TC-ER approved
- 3 ground design for optimal electrical performance
- Sunlight, flame, and moisture resistant

ÖLFLEX®
FD VFD

Description

- ÖLFLEX® FD VFD is a shielded **continuous flex** motor supply cable
- It is designed with the Lapp Surge Guard insulation system, which includes a semi-conductive layer made to withstand nonlinear power distortions associated with VFD drives in industrial applications

Application

- VFD drives and motor connections in continuous flex applications
- Plastic extrusion
- On/off, slow down/speed up applications

USPs

- Continuous flex rated for cable chain applications
- Double-shielded for extra protection
- UL TC-ER & c(UL) CIC/TC approval

ÖLFLEX® SERVO 9YSLCY-JB

Description

- ÖLFLEX® SERVO 9YSLCY-JB is a highly flexible power cable for large horsepower motors and VFD drives
- It has a double shield with polypropylene-insulated conductors for optimal low-loss power transmission when compared to PVC

Application

- Motor connections for large motors and drives
- Textile, paper, chemical, machine tool
- Heavy industry
- Conveying technology

USPs

- Flexible for easier routing
- **UL & CSA AWM approved**
- Black-jacketed version: 3 symmetrical grounds for improved EMC performance

ÖLFLEX® SERVO 2YSLCY-JB

Description

- ÖLFLEX® SERVO 2YSLCY-JB is a highly flexible power cable for large horsepower motors and VFD drives
- It has a double shield with polyethylene-insulated conductors for optimal low-loss power transmission when compared to PVC

Application

- Motor connections for large motors and drives
- Textile, paper, chemical, machine tool
- Heavy industry
- Conveying technology

USPs

- Flexible for easier routing
- For large power drive systems
- Black jacketed version: 3 symmetrical grounds for improved EMC performance

We had conducted numerous tests on a number of cable properties to show why LAPP VFD cables stand out from the competition

LAPP VFD ADVANTAGES

	Products			
	ÖLFLEX® VFD 2XL	ÖLFLEX® VFD SLIM	VFD Generic Type B	
	.045 XLPE (plus)	Surge Guard	.045 XLPE	
	Jackets			
	Specially formulated thermoplastic elastomer	Specially formulated thermoplastic polymer	PVC	
Property	**Ratings**			**Comments**
Voltage Rating (volts)	1	2	2	#1 - 2000V rated (UL TC-ER)
	1	1	2	#1 - WTTC 1000V FT4
	1	1	2	#1 - c(UL) CIC/TC 600V
Dielectric Withstand (volts)	1	2	2	#1 - 3x voltage
DC Resistance (ohms/ 1000 ft.)	1	1	2	#1 - Stranding meets UL & VDE
Voltage Drop (volts)	1	1	2	#1 - Lowest voltage drop
Longer Lengths (feet)	1	1	2	#1 - Longest lengths
Ampacity (amperes)	1	1	2	#1 - Highest ampacity
Corona Testing (voltage)	2	1	2	#1 - Highest inception/extinction
Capacitance (conductor – conductor)	1	2	1	#1 - Lowest capacitance
Impedance (ohms)	1	2	1	#1 - Higher impedance
Oil (aging)	1	1	3	#1 - Meets Oil Res II
Low Temperature (degrees Celsius)	1	1	3	#1 - Meets -25°C cold impact
	1	1	2	#1 - Meets -40°C cold bend
Flexibility (durometer)	1	1	3	#1 - Highly flexible
Mechanical (pound-force)	1	1	3	#1 - Crush/impact force
Shield Effectiveness (decibels)	1	1	2	LAPP Super EMI Shield vs. AM tape
	1 = Best	2 = Average	3 = Fair	

Reference: OLFLEX VFD White Paper, LAPP USA

Complete any VFD installation with SKINTOP®

The SKINTOP® MS-NPT BRUSH & MS-M BRUSH provide centered, fixed strain relief with a liquid-tight and dust-proof seal, all in one step. Simply insert the cable, push the braid shield under the innovative EMC brush, tighten the cap, and the connection is made.

The SKINTOP® MS-M BRUSH PLUS sizes offer extra large clamping ranges.

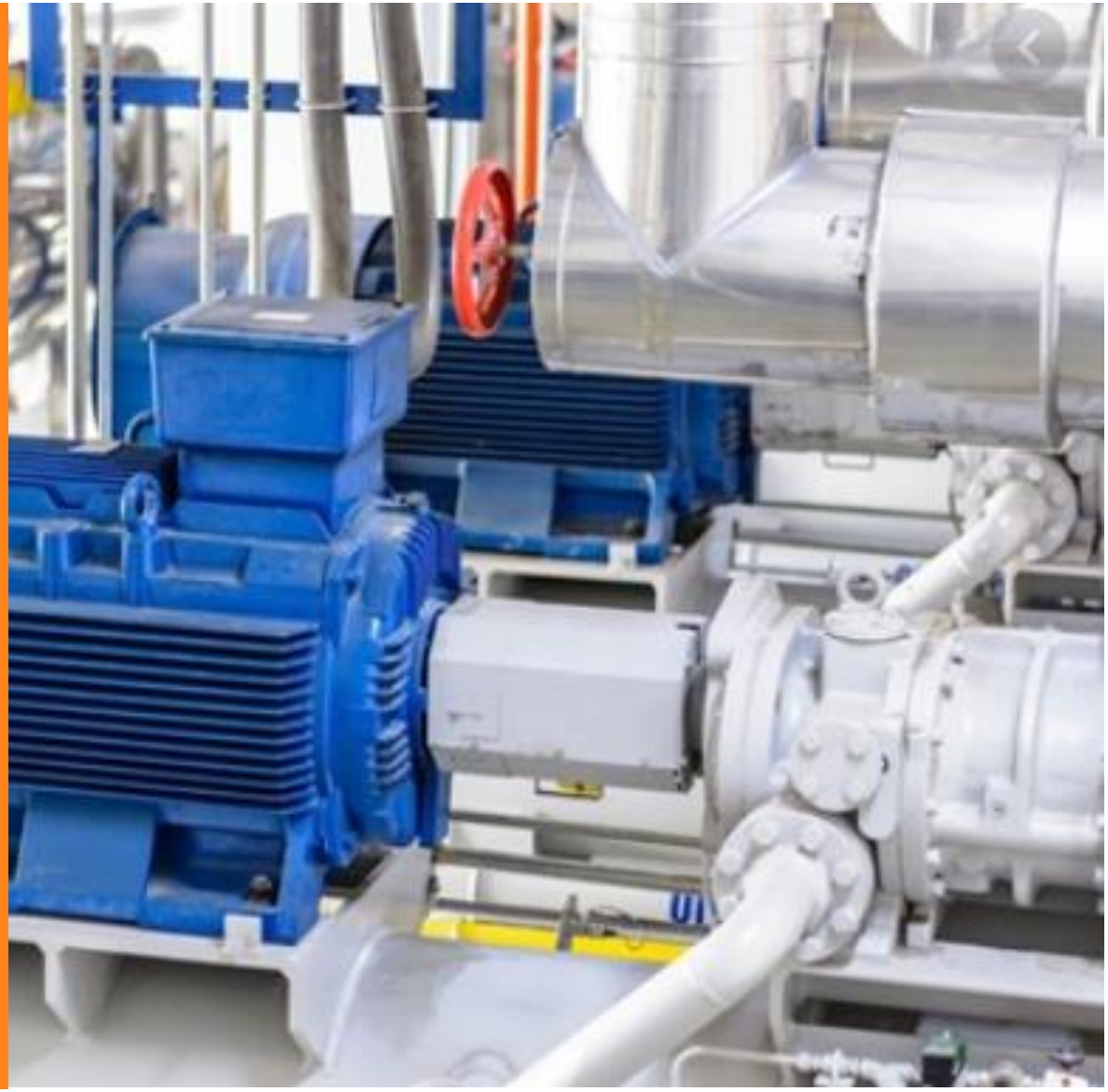
Approvals: NPT Thread

Approvals: Metric Thread

Application Advantage

- Faster, easier, reliable screen contact
- Maximum assembly and adjustment possibilities
- 360° contact area allows for optimal low-resistance current return ground path

TARGET APPLICATIONS & SUCCESS STORIES



Reference: danfoss.com

VFD Applications

Pumps

Water treatment processes come with inherent variability, resulting in changing load demands to maintain control and process optimization

Fans

Heat up, cool down or any ventilation application is not just of interest in different industrial environments

Air Compressors

Oil & gas, chemical, food & beverage, and building automation are the major industries that demand for air compressors

VFD Applications II

Conveyors

Heavier loads requires more torque. Save energy by matching requirements any time.

Mixers

Would a smoothie be a smoothie if the stirring equipment and mixer wouldn't run smoothly…?

Others

There are many other applications where using VFDs enable increasing efficiency and optimizing output, e.g. elevators

Customer success story

Rugged VFD cable handles tight bends – rolling stock application

ÖLFLEX® VFD SLIM was approved together with SILVYN AS flexible conduit and SKINTOP® cable glands as the solution

Reference: https://lappdigitallibrary.cld.bz/Rugged-VFD-Cable

Customer Reference - BMW

BMW plant, USA

Factory Floor…

equipped with ÖLFLEX® SERVO / VFD

COMMON FAILURES & INCORRECT INSTALLATION MODES FROM CUSTOMERS

High frequency currents occur, causing damage to the motors

Customer Challenge

- New drive installations can have the motor bearings fail only a few months after startup

Failure analysis

- Failure can be caused by high frequency currents, which flow through the motor bearings
- Incidence of damage these cause has increased over the years
- Main reason is modern variable speed drives with their fast-rising voltage pulses and high switching frequencies can cause current pulses through the bearings whose repeated discharging can gradually erode the bearing races

Reference: ABB Technical guide: Bearing currents in modern AC drive systems

These are the ways to prevent high frequency bearing currents

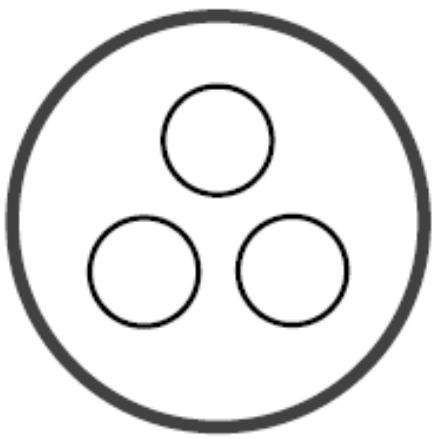
- Proper cabling and earthing system
- Damping high frequency common mode current
- Breaking bearing current loops

Reference: ABB Technical guide: Bearing currents in modern AC drive systems

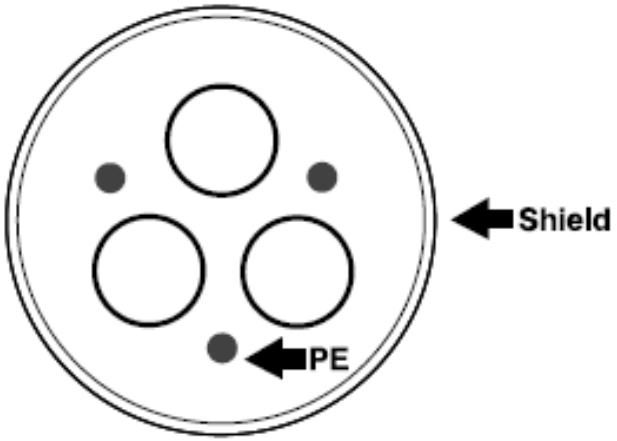
These are the ways to prevent high frequency bearing currents

Use symmetrical multicore motor cables

- Earth (protective earth, PE) connector arrangement in the motor cable must be symmetrical to avoid bearing currents at fundamental frequency
- **3C + 3E configuration**



PE-conductor and shield

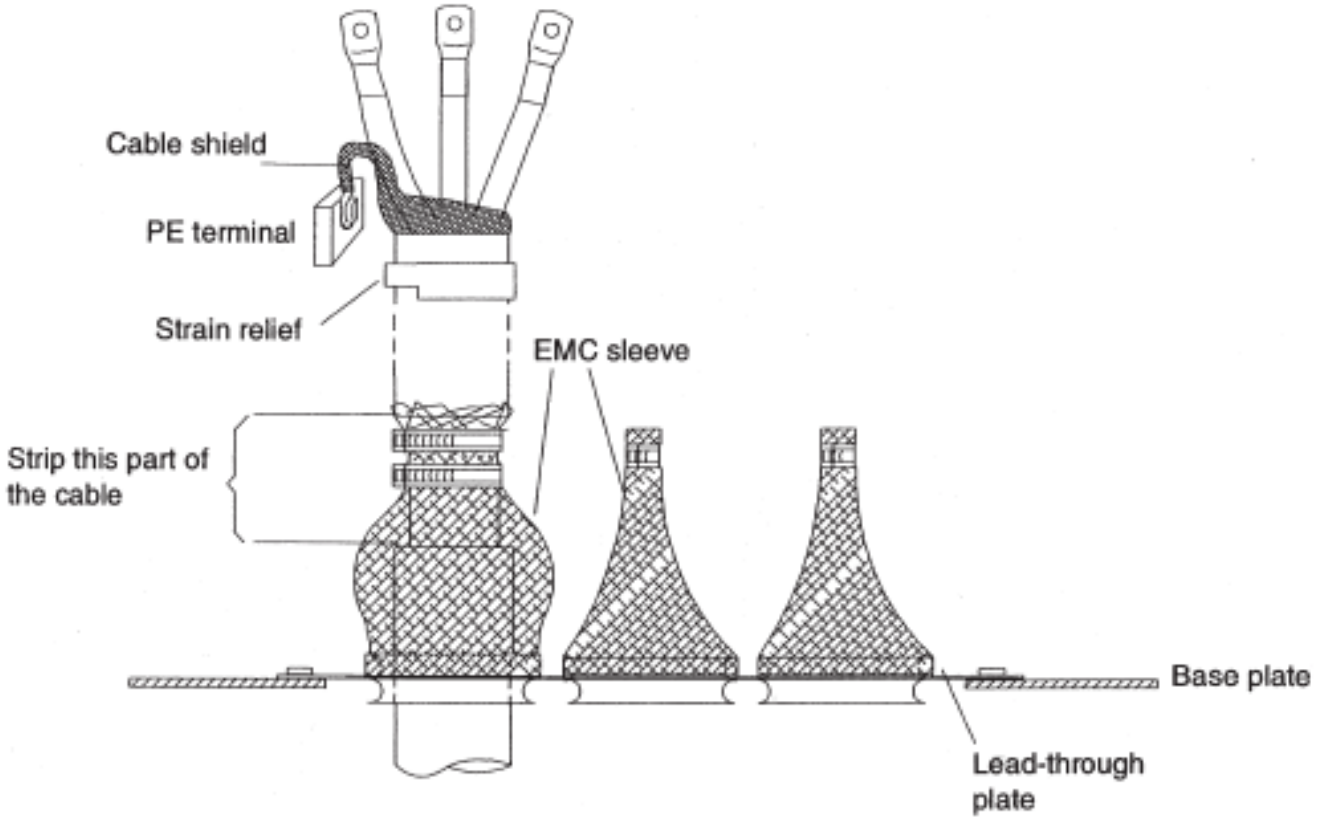


Reference: ABB Technical guide: Bearing currents in modern AC drive systems

These are the ways to prevent high frequency bearing currents

Damping high frequency common mode current

- Defining the shortest impedance path back to the inverter



Reference: ABB Technical guide: Bearing currents in modern AC drive systems

Shielding is important to a stable bus communication signal from VFD

Customer Challenge

Failure analysis

- Low impedance on the PROFIBUS cables in certain areas
- Shielding not per PROFIBUS standards

Reference: https://profinews.com/2020/06/profibus-indias-largest-brewery

Importance of shielding and grounding of cables for PROFIBUS application

VFD shielding not as per standards

VFD shielding corrected

Reference: https://profinews.com/2020/06/profibus-indias-largest-brewery

THANK YOU