

# 20 Nm TFD<sup>®</sup> Steering Unit

## Integrated Solution for Steer-by-Wire Applications

The LORD 20 Nm Tactile Feedback Device (TFD<sup>®</sup>) Steering Unit is a key component of Steer-by-Wire (SbW) systems. This device provides an integrated solution that measures steering position, and provides controllable resistive steering torque in real time, delivering high-fidelity tactile feedback and maximum control to the operator.

LORD Corporation has pioneered TFD Steering Units since 1999 when the first device was commercialized in a forklift truck application. The unit is maintenance-free and will never require inspection or adjustment during the expected service life. There are very few moving parts in the design which greatly enhances durability. With more than 400,000 TFD Steering Units in service today, LORD Corporation has a long history of providing reliable and safe devices across a variety of applications in multiple industries, including material handling, agriculture, construction, marine and small electric vehicles.

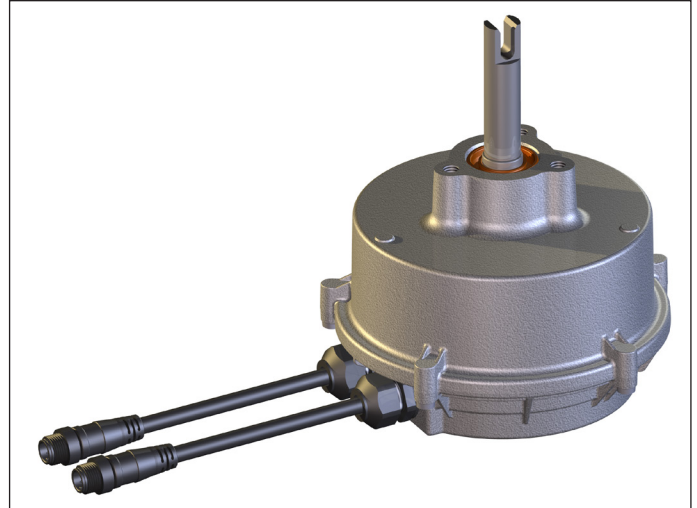
### Features & Benefits

**Tunable Steering Settings** – an integrated controller uses inputs from the CAN-bus and proprietary algorithms to adjust how the steering system feels to the operator during various operating conditions, giving OEMs and vehicle integrators greater design freedom and reduced development time.

**Improved Operator Ergonomics** – LORD patented magnetically-responsive (MR) materials provide smooth consistent resistive steering torque, giving the operator a greater sense of connectedness with the vehicle during steering events.

**Integrated Safety** – dual isolated channels with two sensors per channel provides safety redundancy.

**Robust Design** – compact, maintenance free, easy-to-install, functional under a broad set of operating conditions and environments.



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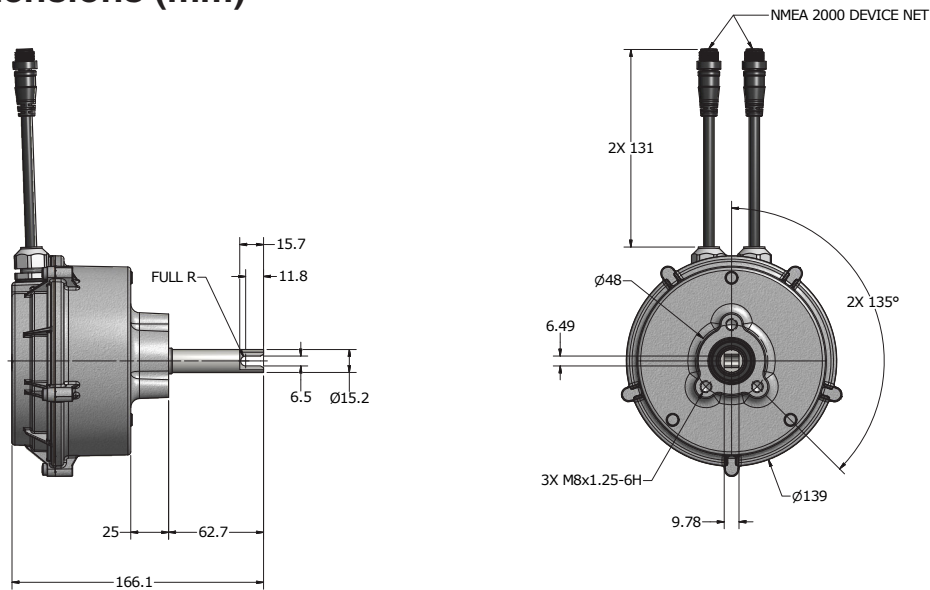
### Key Performance Attributes\*

| Category                                    | Specification   |
|---|---|
| Rated torque at 100% command                | 20 Nm nominal (14.8 lb-ft)  |
| Off-state torque at 0% command              | <1.0 Nm (<0.75 lb-ft)   |
| Operating speed                             | 120 rpm maximum   |
| Product weight                              | 3.3 kg (7.3 lbs)  |
| Supply voltage                              | 9-36 VDC  |
| System power draw (continuous)              | 2.6 W   |
| System power draw (at 100% current command) | 17 W  |
| CAN   | Two independent CAN 2.0B transceivers (29-bit identifiers), 250 kBaud |
| Sensor type                                 | Absolute, non-contact, Hall effect                                    |
| Sensor resolution                           | 14-bit  |
| Cable connection                            | Dual NMEA 2000 Devicenet  |
| Shaft connection                            | Compatible with U-Flex X52 tilt mechanism                             |
| Installation orientation                    | Vertical (shaft up) to horizontal (-10°)                              |
| Axial force limit                           | 1500 N max (337 lbf)  |
| Operating temperature                       | -15°C to 85°C (5°F to 185°F)  |
| Environmental protection                    | IP67, 1000-hr salt fog  |
| Safety rating                               | SIL2 design intent  |

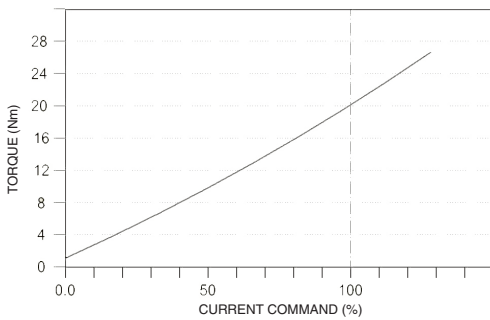
\*Data is typical and not to be used for specification purposes.

# LORD PRODUCT INFORMATION

## Product Dimensions (mm)



## Typical Torque Characteristic



Rated torque shall reduce by no more than 25% of the original measured value over the life of the part (1 million cycles)

## Electromagnetic Compatibility

| Test                    | Standard             | Level  | Rating      |
|-------------------------|----------------------|--|-------------|
| ESD Immunity            | ISO 25197, §10.10.8  | Contact 6 kV, Air 8 kV   | A           |
| LF Conducted Immunity   | ISO 25197, §10.10.3  | 10% DC supply voltage  | A           |
| RF Conducted Immunity   | ISO 25197, §10.10.4  | 3 Vrms with 10 Vrms spot frequencies   | A           |
| Radiated Immunity       | ISO 25197, §10.10.5  | 30 V/m   | A           |
| EFT, Burst Immunity     | ISO 25197, §10.10.6  | 2 kV   | A           |
| Load Dump               | SAE J1113-11:2012    | Pulse 5 B, Vs = 80 V, Vs* = 50 V, tr = 10ms, td = 400ms, Ri = 4 Ω, 4 pulses, 45 secs pulse repetition time | A           |
| Power Supply Variations | ISO 25197, §10.10.9  | +20% / -25%  | A           |
| Radiated Emissions      | ISO 25197, §10.10.10 | Ref IEC 60533 §6.2.1 for bridge and deck zones   | Below limit |
| Conducted Emissions     | ISO 25197, §10.10.11 | Ref IEC 60533 §6.2.1 for bridge and deck zones   | Below limit |

Rating: A – Normal performance before, during, and after exposure

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