

# MKF-ESW-01

ELMA Electronic Power Steering, Panel Mounted



## DESCRIPTION

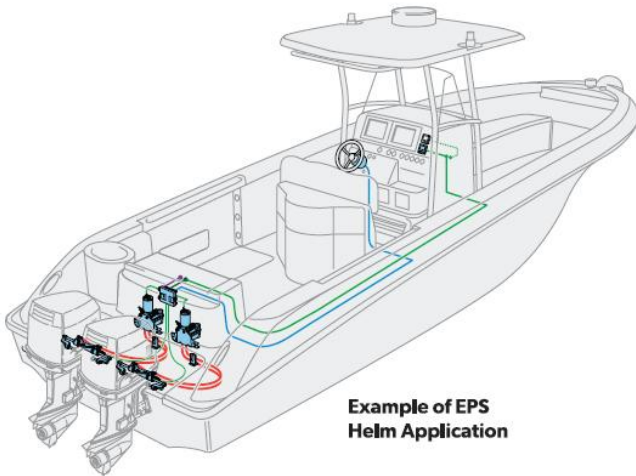
ELMKF-ESW-01 is a professional electronic power steering rudder designed specifically for the marine environment. The electronic steering rudder fits seamlessly into the instrument panel. It is fully plug-and-play with CAN-compatible ship control systems. Fully customizable software maximizes comfort and performance in every installation, whether on board a marine or industrial application.

## FEATURES

- Friction resistance positioning
- Adjustable steering resistance with speed
- Programmable rotation angle
- Programmable number of turns
- Automatically locks to the set number of turns and angles
- Automatic detection of 12VDC or 24VDC power supply
- Features dual redundant, non-contact magneto resistive rotation sensors
- Standard fault-tolerant CAN bus output
- Proprietary protocols can be selected based on customer requirements
- Works with hydraulic steering pump to minimize power consumption
- Standard steering wheel installation dimensions
- Rugged and durable electronic steering device
- Double angular contact bearings with greater side load capacity

## SPECIFICATION

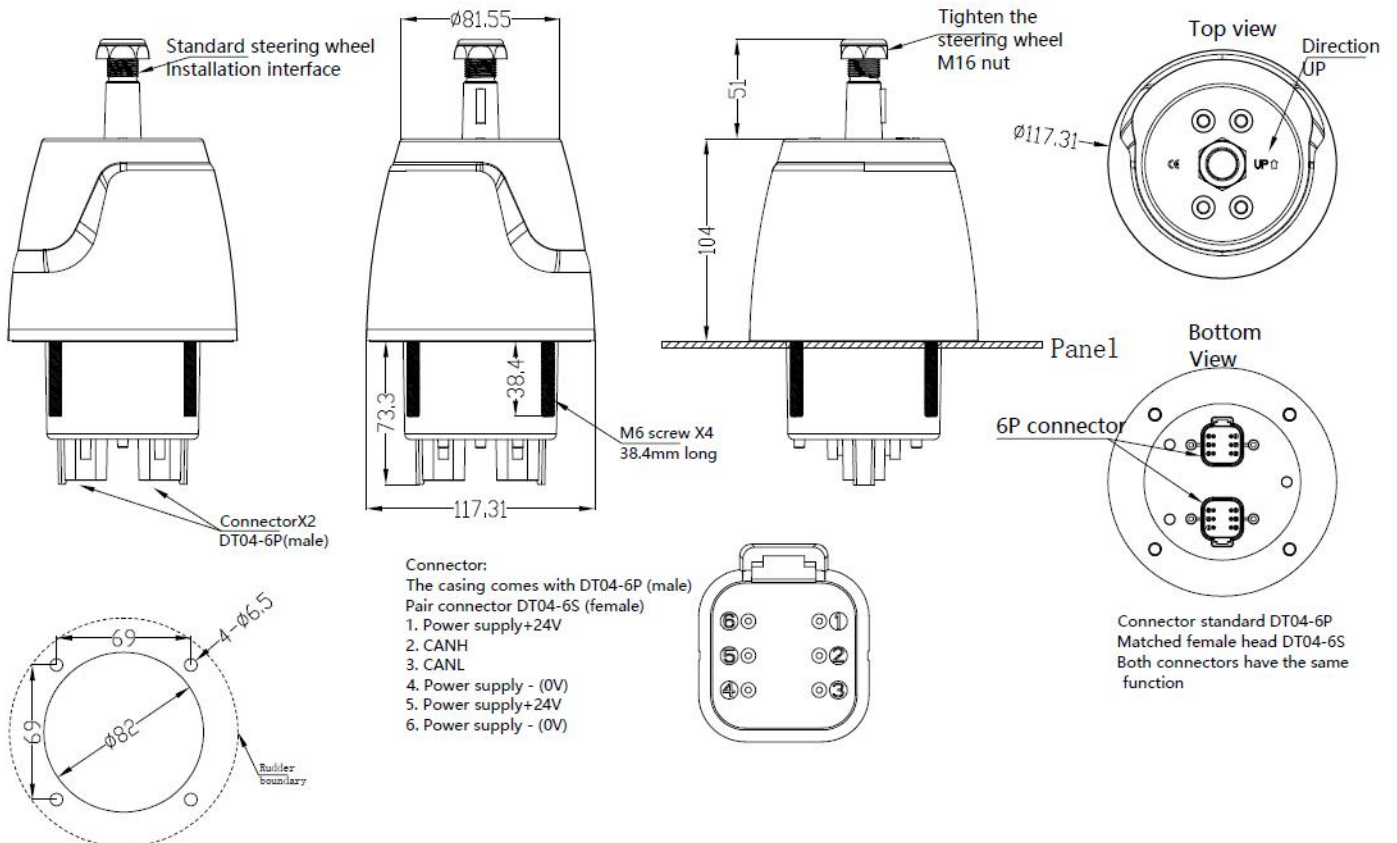
|                                                        |                                                                        |
|--------------------------------------------------------|------------------------------------------------------------------------|
| Connectors                                             | DT04-6P x 2pcs / Built in CAN network tee for multi-station connection |
| Adjustable End Stop Brake Torque                       | 15-200 in-lbs [1-20Nm]                                                 |
| Adjustable Background Steering Resistance              | 15-27 in-lbs [1-3Nm]                                                   |
| Zero Drift, Low Deadband                               | less than 3.5°                                                         |
| Steering Angle Sensor Resolution                       | 0.05° helm angle                                                       |
| Steering Torque Variability, Relative, Both directions | +/- 20%                                                                |
| Brake Deactivation Movement                            | 0.25° helm angle                                                       |
| Side Load Resistance                                   | 100 lbf [ABYC P-21]                                                    |
| Durability                                             | 100,000 steering cycles lock-to-lock [ABYC P-27]                       |
| Flammability Rating                                    | V0 [UL-94]• Connector tensile pull                                     |
| Resistance                                             | 60 lbf                                                                 |
| Operating voltage                                      | 9-16 VDC                                                               |
| Max current drawn                                      | 2 Amps, at maximum brake force                                         |
| Typical current drawn                                  | Less than 50mA                                                         |
| Power transient protection                             | Switching transient, starter motor disturbance, and load dump          |
| Conducted immunity                                     | 10 Vrms, Criteria A                                                    |
| Radiated immunity                                      | 30V/m, Criteria A                                                      |
| Electrostatic discharge protection                     | 6kV contact, 8kV air                                                   |
| Compass safe distance                                  | 61 cm, at 1°                                                           |
| HS-CAN                                                 | High-speed CAN 2.0B 250 kbps                                           |
| FT-CAN                                                 | Fault tolerant CAN 125 kbps                                            |
| Operating temperature                                  | -40°C to +80°C                                                         |
| Storage temperature                                    | -45°C to +85°C                                                         |
| Corrosion resistance                                   | 300 hours salt spray                                                   |
| Water ingress protection                               | IPX7                                                                   |
| Random vibration                                       | 0.0284 g <sup>2</sup> /Hz                                              |
| Resonant vibration                                     | 4 G zero-peak, 20-2000 Hz                                              |
| Thermal shock                                          | 100 cycles                                                             |
| Mechanical shock                                       | 50 G, 11 msec half-sine shape                                          |



**Example of EPS  
Helm Application**

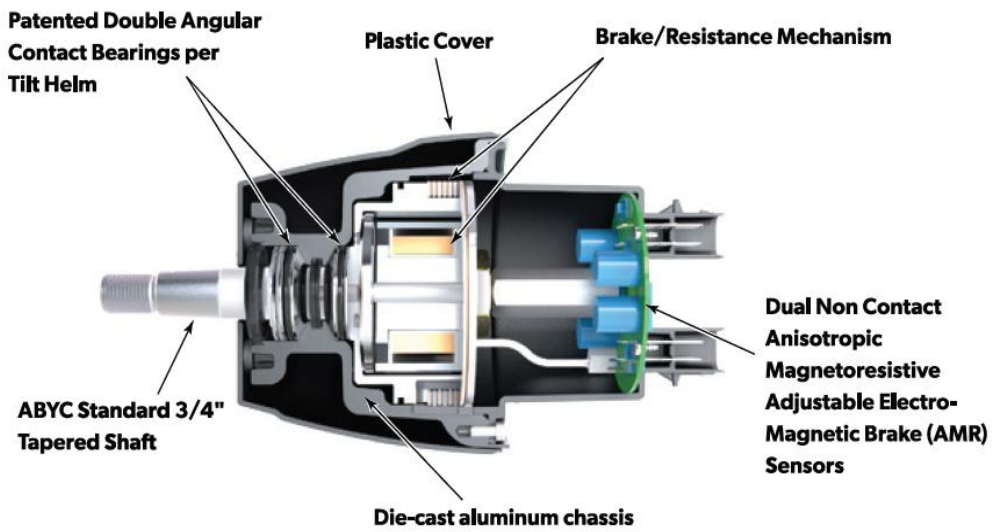


**DRAWING**



**Install cutout size**

## STRUCTURAL SCHEMATIC DIAGRAM



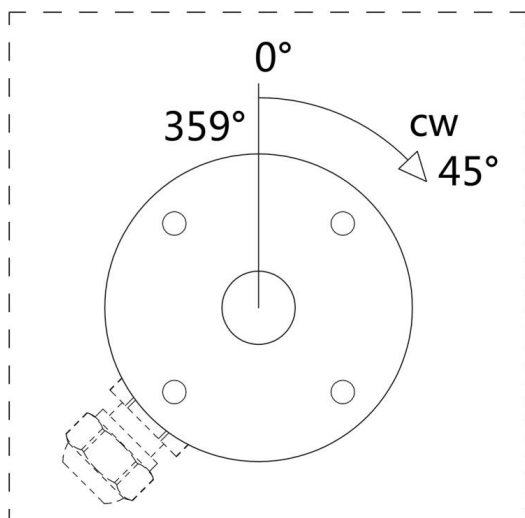
Measurement accuracy:

Angle measurement accuracy is 16 bits, and the corresponding value of 0-360 degrees is 0-65535

The measurement accuracy after stable filtering is 15 bits

| Value | Angle   |
|-------|---------|
| 0     | 0       |
| 1     | 0.005   |
| 2     | 0.011   |
| ....  | ....    |
| 65534 | 359.989 |
| 65535 | 359.995 |

Rotation direction CW clockwise:



The number of revolutions changes after 0: CW clockwise +1, CCW counterclockwise -1

### Communication protocol

Electronic steering rudder sends data frame (steering rudder → controller)

CAN2.0B baud rate 250K ID=0CFDD900+Address

|       | Bit7                                                          | Bit6                            | Bit5                            | Bit4                                     | Bit3 | Bit2 | Bit1 | Bit0                        | Description                                       |
|-------|---------------------------------------------------------------|---------------------------------|---------------------------------|------------------------------------------|------|------|------|-----------------------------|---------------------------------------------------|
| Byte0 | Rotation direction<br>1=clockwise<br>0=counterclockwise       | Sensor 2<br>0=Normal<br>1=Error | Sensor 1<br>0=Normal<br>1=Error | Redundancy<br>0=Normal<br>1=Out of range |      |      |      | 0<br>Disable<br>1<br>Enable | Status indication<br>Enable                       |
| Byte1 | -16~+16                                                       |                                 |                                 |                                          |      |      |      |                             | Number of turns of steering rudder<br>-128 ~ +127 |
| Byte2 | 0-360 degree rotation range, corresponding to 0X0000~0XFFFF   |                                 |                                 |                                          |      |      |      |                             | Steering rudder angle<br>High byte                |
| Byte3 |                                                               |                                 |                                 |                                          |      |      |      |                             | Steering rudder angle<br>Low byte                 |
| Byte4 | 0~16                                                          |                                 |                                 |                                          |      |      |      |                             | Range: 0~16 turns                                 |
| Byte5 | 0-360 degree rotation range, corresponding to 0X0000 ~ 0XFFFF |                                 |                                 |                                          |      |      |      |                             | Range angle<br>High byte                          |
| Byte6 |                                                               |                                 |                                 |                                          |      |      |      |                             | Range angle<br>Low byte                           |
| Byte7 | ±100%                                                         |                                 |                                 |                                          |      |      |      |                             | Full scale percentage<br>(positive and negative)  |

Note:

- ① Enabled by default when powered on ("damping setting" may be turned off by command);
  - ② Rotation direction, 0 when powered on, the most recent rotation direction (1=clockwise/0=counterclockwise);
  - ③ Range: refers to the rotation range from the center position (directly forward) to one side, such as ±1 and a half turns: number of turns = 01, range angle = 7FFF;
- The range is a constant of the rudder, and it will never change after setting;
- ④ Rotation direction: the most recent rotation direction when the rudder does not move;

Address = 01-255

When there are multiple stations, the ID is different (the method of setting the ID is introduced later)

Usually the ship is designed with two stations, of course there are also designs with three stations or more

Station 1 Address = 01 CAN ID = 0x0CFDD901

Station 2 Address = 02 CAN ID = 0x0CFDD902

Station 3 Address = 03 CAN ID = 0x0CFDD903

Electronic steering rudder receives data frame (controller→steering rudder)

(1) Current rudder angle setting (when powered on, the controller sends the current rudder angle information to the steering rudder so that the two can be synchronized)

CAN2.0B baud rate 250K ID=0CFDDA00+Address

|       | Bit7                                                                                         | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Description                     |
|-------|----------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|---------------------------------|
| Byte0 |                                                                                              |      |      |      |      |      |      |      | 0XFA                            |
| Byte1 |                                                                                              |      |      |      |      |      |      |      | 0X01                            |
| Byte2 | Real-time detection of current rudder angle value/±100%<br>Mid-position = 0, full rudder 100 |      |      |      |      |      |      |      | Current rudder angle percentage |
| Byte3 |                                                                                              |      |      |      |      |      |      |      | 0X00                            |
| Byte4 |                                                                                              |      |      |      |      |      |      |      | 0X00                            |
| Byte5 |                                                                                              |      |      |      |      |      |      |      | 0X00                            |
| Byte6 |                                                                                              |      |      |      |      |      |      |      | 0X00                            |
| Byte7 |                                                                                              |      |      |      |      |      |      |      | 0XA5                            |

Power-on synchronization method:

① After power-on, the steering wheel does not move, and the servo turns to the direction specified by the direction. The above command can be ignored. The number of turns of the steering rudder is 0 by default, and the angle of the steering rudder is the same as that of the steering wheel. The servo will automatically return to the position pointed by the steering wheel;

② After power-on, the servo does not move, and the steering wheel automatically synchronizes to the angle of the servo. After power-on, the controller sends the rudder angle (the above command);

The control first detects the rudder, and sends the rudder angle value command to the ELMKF-ESW-01 steering rudder, then the rudder will automatically calculate the current number of turns, the servo does not move, and the ELMKF-ESW-01 steering rudder automatically synchronizes.

(2) Rotation range setting

The rotation range refers to the maximum rotation range to one side based on the front

CAN2.0B baud rate 250K ID=0CFddb00+Address

|       | Bit7                                                                                                                                             | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Description |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|-------------|
| Byte0 |                                                                                                                                                  |      |      |      |      |      |      |      | 0XFA        |
| Byte1 |                                                                                                                                                  |      |      |      |      |      |      |      | 0X02        |
| Byte2 | Based on the front, the number of circles in one direction, less than 1 circle = 0                                                               |      |      |      |      |      |      |      | 0~16 turns  |
| Byte3 | 0-360 degree rotation range, corresponding to 0X0000-0XFFFF (0-360 degrees)<br>For example, 120 degree rotation = $(120/360)*65536=21845=0x5555$ |      |      |      |      |      |      |      | Angle high  |
| Byte4 |                                                                                                                                                  |      |      |      |      |      |      |      | Angle low   |
| Byte5 |                                                                                                                                                  |      |      |      |      |      |      |      | 0X00        |
| Byte6 |                                                                                                                                                  |      |      |      |      |      |      |      | 0X00        |
| Byte7 |                                                                                                                                                  |      |      |      |      |      |      |      | 0XA5        |

For example: With the front as 0, the rotation range to one side is, for example, ±1 and a half turns, the number of turns = 1, and the angle = 0x7FFF

### (3) Damping setting

CAN2.0B baud rate 250K ID=0CFDDC00+Address

|       | Bit7                                                                                                                                                                          | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Description                      |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|----------------------------------|
| Byte0 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0XFA                             |
| Byte1 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0X03                             |
| Byte2 | It is related to the enable bit of the steering rudder to send data. It is mainly used in multi-station systems. This function can be ignored in single-station applications. |      |      |      |      |      |      |      | Enable<br>00=disable/01=enable   |
| Byte3 | Boot default=0                                                                                                                                                                |      |      |      |      |      |      |      | Damping size<br>Percentage 0-100 |
| Byte4 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0X00                             |
| Byte5 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0X00                             |
| Byte6 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0X00                             |
| Byte7 |                                                                                                                                                                               |      |      |      |      |      |      |      | 0XA5                             |

### (4) Set the communication cycle

CAN2.0B baud rate 250K ID=0CFDDD00+Address

|       | Bit7     | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Description         |
|-------|----------|------|------|------|------|------|------|------|---------------------|
| Byte0 |          |      |      |      |      |      |      |      | 0XFA                |
| Byte1 |          |      |      |      |      |      |      |      | 0X04                |
| Byte2 | 10-250ms |      |      |      |      |      |      |      | Communication cycle |
| Byte3 |          |      |      |      |      |      |      |      | 0X00                |
| Byte4 |          |      |      |      |      |      |      |      | 0X00                |
| Byte5 |          |      |      |      |      |      |      |      | 0X00                |
| Byte6 |          |      |      |      |      |      |      |      | 0X00                |
| Byte7 |          |      |      |      |      |      |      |      | 0XA5                |

## System settings

### 1. Set the 0 reference point of ELMKF-ESW-01 electronic steering rudder

① Power off, UP to the front direction, turn the steering wheel, and enable its position to face forward, which is the position of setting 0 point (angle = 0)

② Power on (more than 20 seconds)

③ Send the command to set 0 point:

CAN ID=00ED0512

Send data: 0xaf 0x09 00 00 00 00 f5 00

④ Turn the steering wheel clockwise about 20 degrees (leave 0 point)

⑤ Send the command to store 0 point:

CAN ID=00ED0512

Send data: 0xaf 0x09 01 00 00 00 f5 00

⑥ Restart after 3 seconds of power off, and the newly set 0 point will take effect.

### 2. Set address Address

CAN ID = 00ED0512

Send data: 0xaf 0x0d 00 00 00 00 Add f5 00

Add = Address 0x01-0xff

For example, set Address = 01 af 0d 00 00 00 01 f5 00

Address = 02 af 0d 00 00 00 02 f5 00

Address = 03 af 0d 00 00 00 03 f5 00