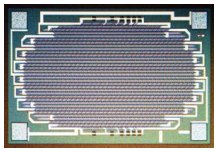
# KMY/KMZ Linear Magnetic Field Sensors



DIEs (MR174B,MRHB)

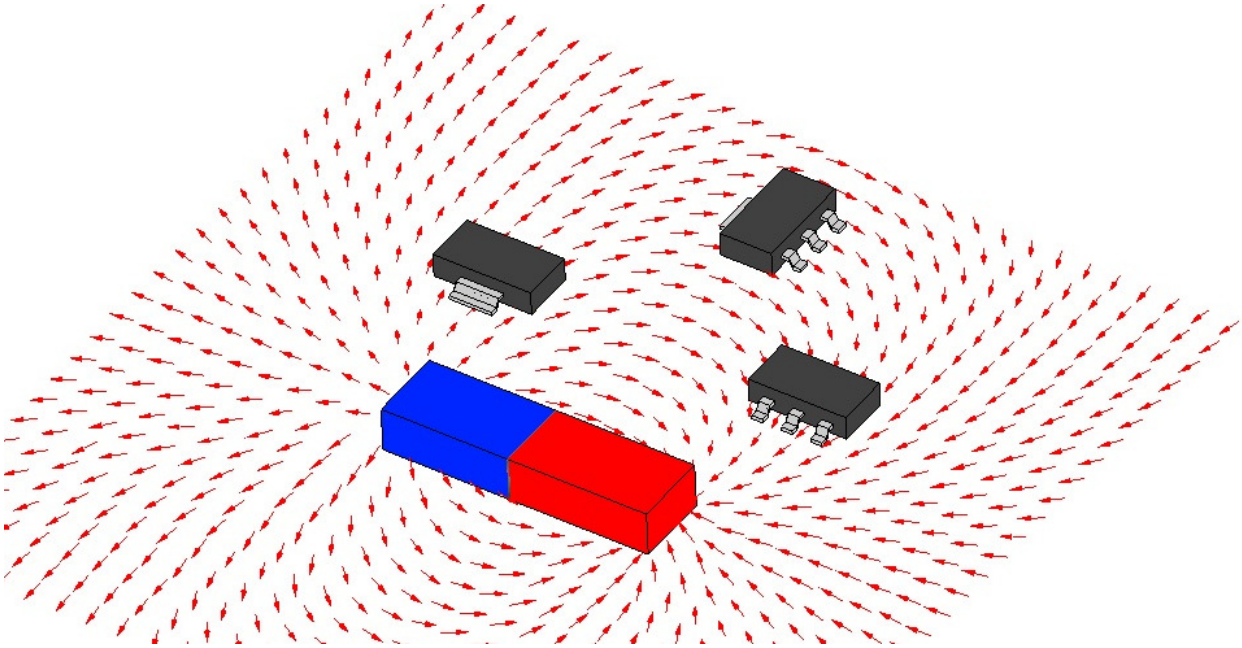

KMY20M

E-Line
KMZ20M

- **AMR sensor**
- **Very high sensitivity**
- **Almost no hysteresis**
- **Various applications**
- **Available with internal magnet**
- **Available packaged or as dies**

## DESCRIPTION

Due to its featured properties - high sensitivity and almost no hysteresis – the **KMY** / **KMZ** sensors are used in a wide range of applications, like magnetic field measurement, revolution counters, proximity detecting, and position measurement.



An uniaxial linear magnetic field will generate a linear output within the specified magnetic field range.

## FEATURES

- Output proportional to magnetic field strength with very high sensitivity
- Very small hysteresis
- Large operating temperature range, from -40℃ up to +150 ℃
- Highly reliable
- With / without internal magnet

## APPLICATIONS

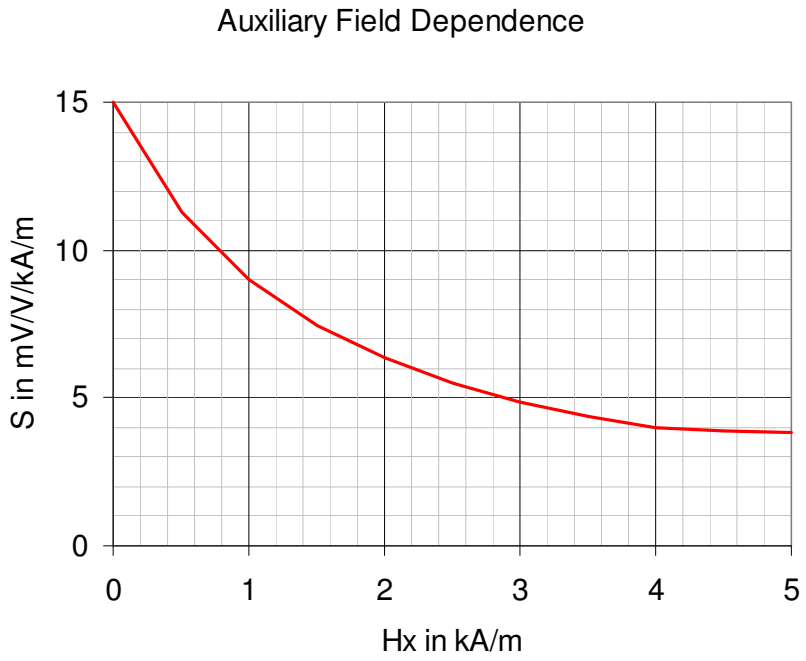
- Detection of very weak magnetic fields, like earth magnetic field, or field generated by small magnetic particles
- Detection of objects that distort non-local magnetic fields
- Revolution measurement on ferromagnetic gears
- Contactless switch
- Contactless displacement sensor

# KMY/KMZ Linear Magnetic Field Sensors

## DESCRIPTION

An uniaxial linear magnetic field (in y-direction) will generate a linear output within the specified magnetic field range. The sensor is available in two types: the **KMY 20 M** and **KMZ 20 M** sensor types contain intrinsic magnets which provide an auxiliary magnetic field (in x-direction) at the sensor die which prevents magnetic domains from flipping irregularly.

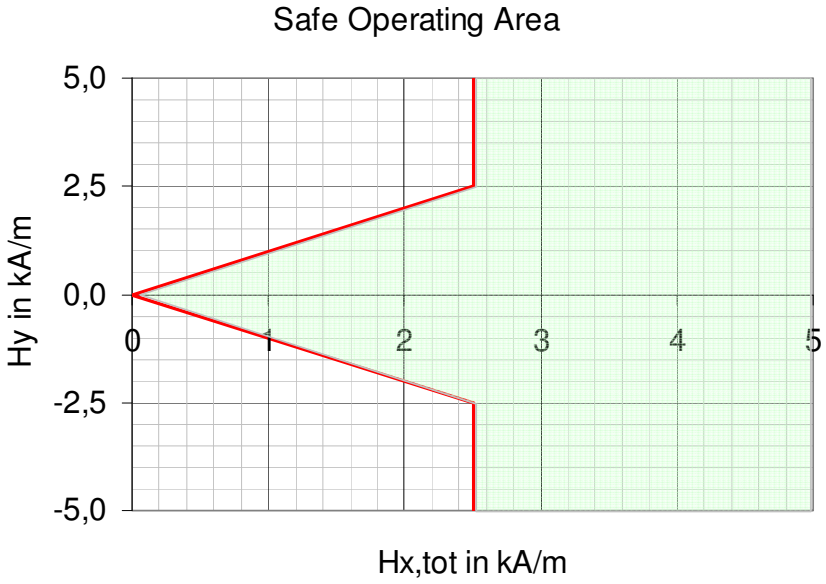
If the dies **MR174B** and **MRHB** or the **KMY 20 S** / **KMZ 20 S** are used, the auxiliary field has to be provided by the user. The dependence of the sensitivity with auxiliary field strength is depicted in the figure aside.




Auxiliary field strengths below Hx<1.5 kA/m are not recommended, as small disturbances may flip the magnetization domains. Sometimes, the magnetic conditions in the application may provide enough Hx bias field stabilization.

If a bias field Hx is not applied or Hx is less than 2.5 kA/m, the sensor may be used only in a limited field range Hy, depending on the present total bias field Hx,tot. In this case, it is strongly recommended to 'premagnetize' the sensor, i.e. align all magnetic domains consistently, prior to the measurement.
Hx,tot is the sum of all acting magnetic fields in x direction at the sensor die.

**Do not use the sensor outside the safe operating area.** Leaving the save operating area can destroy an existing premagnetization and therefore will lead to unreproducible sensor signals.



# KMY/KMZ Linear Magnetic Field Sensors

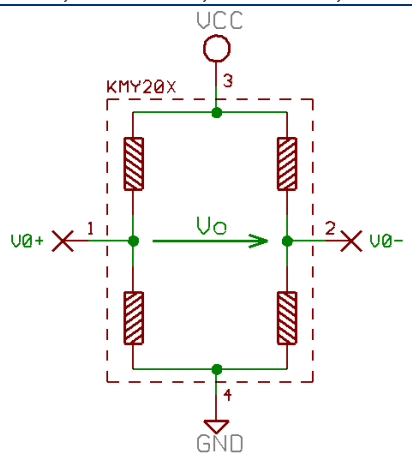
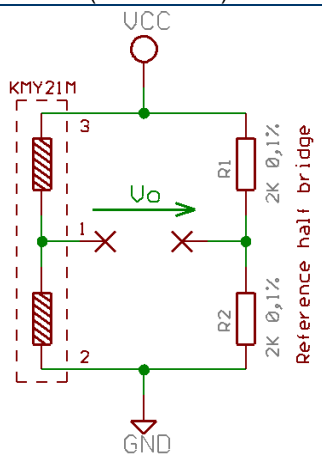
## CHARACTERISTIC VALUES / SENSOR SPECIFICATIONS

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Operating Limits** | | | | | | |
| max. supply voltage | $V_{cc,max}$ | | | | 10 | V |
| max. current | $I_{cc,max}$ | SOT223 | | | 9 | mA |
| | | E-Line | | | 9 | mA |
| operating temperature | $T_{op}$ | SOT223, E-Line | -40 | | +150 | °C |
| storage temperature | $T_{st}$ | SOT223, E-Line | -40 | | +150 | °C |
| **General Sensor Specifications** | | | | | | |
| TC of amplitude | TCSV | Condition A, C | -0.36 | -0.32 | -0.28 | %/K |
| TC of resistance | TCBR | Condition A, C | +0.27 | +0.32 | +0.37 | %/K |
| TC of offset | TCVoff | Condition A, C | -4 | 0 | +4 | µV/V/K |
| **Sensor Specifications KMY 20, KMZ 20 (T=25 °C, Hx=3 kA/m)** | | | | | | |
| Supply voltage | $V_{cc}$ | Condition A, B | | 5 | | V |
| Bridge resistance | $R_b$ | Condition A, B | 1200 | 1700 | 2200 | Ω |
| Output signal range | $\Delta V_0/V_{cc}$ | Condition A, B | 16 | 20 | 24 | mV/V |
| Offset voltage | $V_{off}/V_{cc}$ | Condition A, B | -1 | 0 | +1 | mV/V |
| Sensitivity | S | Condition A, B | 3.7 | 4.7 | 5.7 | mV/V/kA/m |
| Hysteresis | $V_H/V_{cc}$ | Condition A, B | - | - | 50 | µV/V |
| **Sensor Specifications KMY 21 M (T=25 °C, Hx=2.5 kA/m)** | | | | | | |
| Supply voltage | $V_{cc}$ | Condition A, B | | 5 | | V |
| Bridge resistance | $R_b$ | Condition A, B | 1100 | 1500 | 1900 | Ω |
| Output signal range | $\Delta V_0/V_{cc}$ | Condition A, B | 8 | 9.5 | 12 | mV/V |
| Offset voltage | $V_{off}/V_{cc}$ | Condition A, B | 48 | 50 | 52 | %Vcc |
| Sensitivity | S | Condition A, B | 2.05 | 2.50 | 3.10 | mV/V/kA/m |
| Hysteresis | $V_H/V_{cc}$ | Condition A, B | - | - | 50 | µV/V |

Stress above one or more of the limiting values may cause permanent damage to the device. Exposure to limiting values for extended periods may affect device reliability.

# KMY/KMZ Linear Magnetic Field Sensors

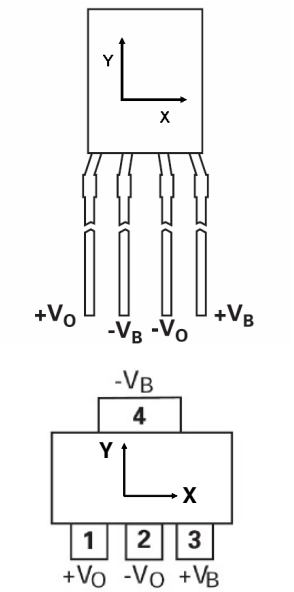
## MEASUREMENT CONDITIONS

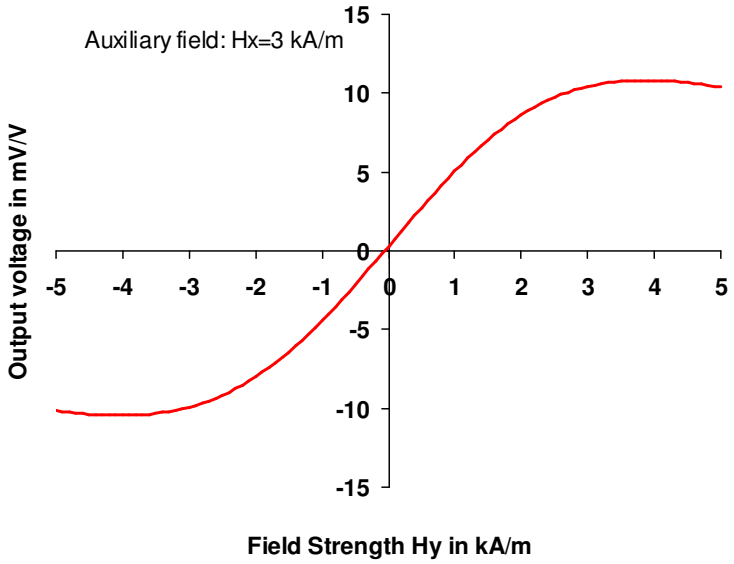
| Parameter | Symbol | Unit | Condition |
|---|---|---|---|
| **Condition A: Set Up Conditions** | | | |
| Ambient temperature | T | ℃ | 23±5 |
| Supply voltage | $V_{cc}$ | V | 5 |
| Output voltage | $V_O$<br>$V_O/V_{cc}$ | mV<br>mV/V | $V_O=(V_{0+}-V_{0-})$<br>output voltages are also given independently on supply voltage: example: $Vo/Vcc=(V_{0+}-V_{0-})/Vcc$<br>measure MR half bridge against reference half bridge |
| Reference half bridge | | | 2* 2 kΩ 0.1% |
| for full bridge sensors<br>(KMY 20 S, KMY 20 M, KMZ 20 S, KMZ 20 M) | | | for half bridge sensors<br>(KMY 21 M) |
|  | | |  |
| | | | The output voltage of the MR half bridge is measured against a reference half bridge |
| **Condition B: Sensor Specifications (T=23±5 ℃, Hx=3.0±0.5 kA/m)** | | | |
| Output voltage range | $\Delta V_O/V_{cc}$ | mV/V | $H_y=-7...+7\ kA/m;\ \Delta V_O=(V_{O,\max}-V_{O,\min})$ |
| Offset voltage | $V_{off}/V_{cc}$ | mV/V | $H_y=0;\ V_{off}=V_O(H_y)$ |
| Sensitivity | S | (mV/V)/(kA/m) | $H_y=1kA/m;\ S:=\frac{V_0(+H_y)-V_0(-H_y)}{2\cdot V_{cc}}$ |
| Hysteresis | $V_H/V_{cc}$ | µV/V | Hy in kA/m<br>$(V_0(H_y=0;H_y=-1\rightarrow+1)$<br>$-V_0(H_y=0;H_y=+1\rightarrow-1))/V_{cc}$ |
| **C. Sensor Specifications (T=-25℃, +125℃)** | | | |
| Ambient temperatures | T | ℃ | $T_1$=-25 ℃, $T_0$=+25 ℃, $T_2$=+125 ℃ |
| TC of amplitude | *TCSV* | %/K | $TCV=\frac{1}{(T_2-T_1)}\cdot\frac{\Delta V_0/V_{cc}(T_2)-\Delta V_0/V_{cc}(T_1)}{\Delta V_0/V_{cc}(T_1)}\cdot 100$ |
| TC of resistance | *TCBR* | %/K | $TCR=\frac{1}{(T_2-T_1)}\cdot\frac{R(T_2)-R(T_1)}{R(T_1)}\cdot 100\%$ |
| TC of offset | *TCVoff* | (µV/V)/K | $TCVoff=\frac{Voff(T_2)-Voff(T_1)}{(T_2-T_1)}$ |

# KMY/KMZ Linear Magnetic Field Sensors

## SENSOR MODELS

### KMY 20 / KMZ 20

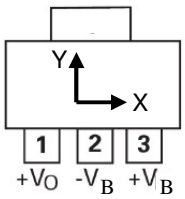


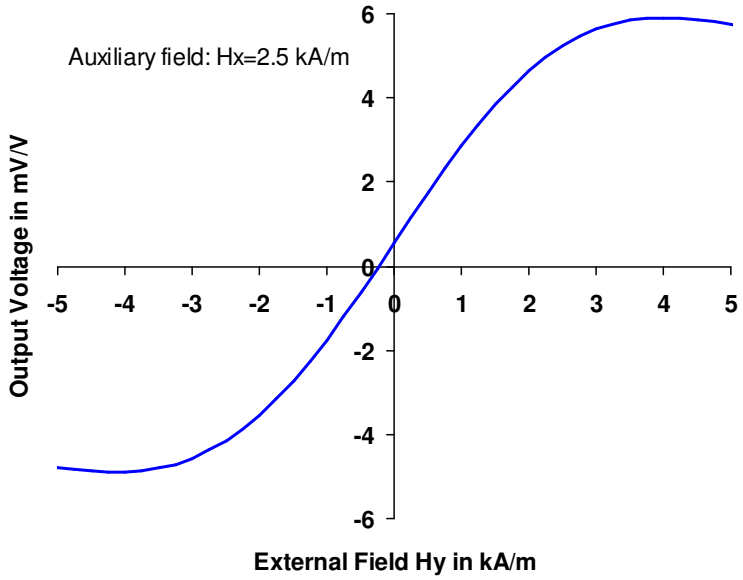

The KMY and KMZ sensors are highly sensitive magnetic field sensors which utilize the anisotropic magneto resistance effect. The KMY 20 and KMZ 20 sensors contain a Wheatstone bridge.

### KMY 21

In contrast to the KMY20 sensor products, the **KMY 21 M** consists of a half bridge, making the sensor well suited for dynamic measurements.

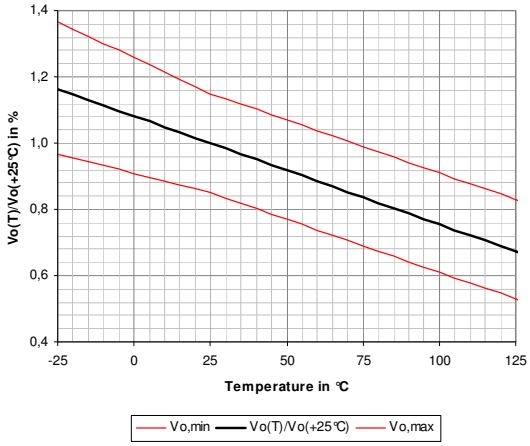



It contains an internal magnet, which provides an auxiliary filed of approx. 2.5 kA/m.

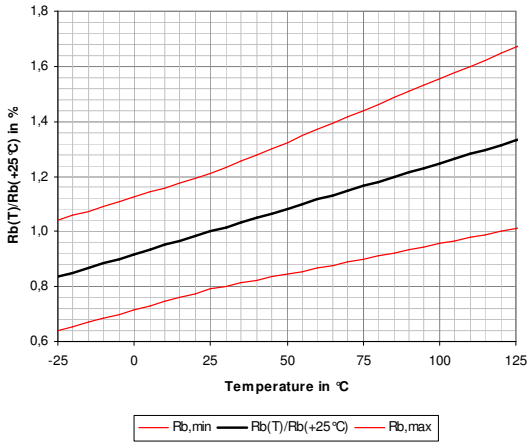


# KMY/KMZ Linear Magnetic Field Sensors

## TEMPERATURE DEPENDENCIES



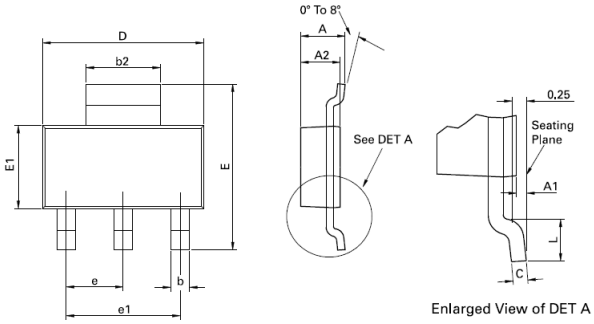

signal amplitude related to room temperature value




bridge resistance related to room temperature value

## PACKAGES

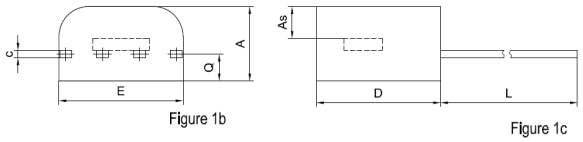
### SOT223

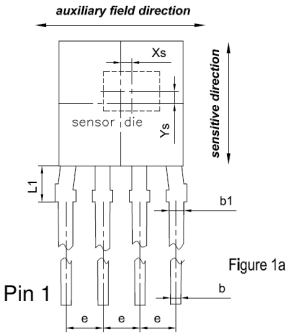



| DIM | Millimeters | | Inches | | DIM | Millimeters | | Inches | |
|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | | Min | Max | Min | Max |
| A | - | 1.80 | - | 0.071 | e | 2.30 BSC | | 0.0905 BSC | |
| A1 | 0.02 | 0.10 | 0.0008 | 0.004 | e1 | 4.60 BSC | | 0.181 BSC | |
| b | 0.66 | 0.84 | 0.026 | 0.033 | E | 6.70 | 7.30 | 0.264 | 0.287 |
| b2 | 2.90 | 3.10 | 0.114 | 0.122 | E1 | 3.30 | 3.70 | 0.130 | 0.146 |
| C | 0.23 | 0.33 | 0.009 | 0.013 | L | 0.90 | - | 0.355 | - |
| D | 6.30 | 6.70 | 0.248 | 0.264 | - | - | - | - | - |

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

### E-LINE 4 PIN




| | Milimeter | | | Inches | | |
|---|---|---|---|---|---|---|
| DIE POS. | KMZ20S | KMZ20M | tolerances | KMZ20S | KMZ20M | tolerances |
| Xs | +0.05 | +0.05 | +/-0.10 | +0.002 | +0.002 | +/-0.004 |
| Ys | +0.50 | +0.50 | +/-0.10 | +0.02 | +0.02 | +/- 0.004 |
| As | 1.05 | 1.05 | +/-0.10 | 0.041 | 0.041 | +/-0.004 |

| | Millimeter | | | Inches | | |
|---|---|---|---|---|---|---|
| DIM | min. | typ. | max. | min. | typ. | max. |
| A | 2.4 | | 2.8 | 0.094 | | 0.110 |
| b | 0,35 | | 0,48 | 0,0138 | | 0,0189 |
| b1 | 0.45 | | 0.60 | 0.0178 | | 0.024 |
| c | 0.25 | | 0.35 | 0.0098 | | 0.0138 |
| D | 4.0 | | 4.4 | 0.157 | | 0.173 |
| E | 3.8 | | 4.4 | 0.150 | | 0.173 |
| L | 12.0 | | 14.0 | 0.472 | | 0.551 |
| e | NOM. 1.25 | | | NOM. 0.049 | | |
| L1 | 1.1 | | 1.3 | 0.043 | | 0.051 |

### DIE LAYOUT AND DIMENSIONS ON REQUEST.

# KMY/KMZ Linear Magnetic Field Sensors

## ORDERING CODE

| DEVICE | DIE | PACKAGE | INTERNAL MAGNET | PART NUMBER |
|---|---|---|---|---|
| **MR174B** | full bridge | wafer | n/a | G-MRCH-002 |
| **MRHB** | half bridge | wafer | n/a | G-MRCH-009 |
| **KMY 20 S** | full bridge | SOT-223 | NO | G-MRCO-006 |
| **KMY 20 M** | full bridge | SOT-223 | YES | G-MRCO-001 |
| **KMY 21 M** | half bridge | SOT-223 | YES | G-MRCO-011 |
| **KMZ 20 S** | full bridge | E-Line | NO | G-MRCO-007 |
| **KMZ 20 M** | full bridge | E-Line | YES | G-MRCO-003 |

## ORDERING INFORMATION