# MLX91217

## High Speed Current Sensor IC

Datasheet

## 1. Features and Benefits

- End-of-line programmable sensor
- Selectable analog ratiometric output
- Measurement range from ±15 to ±450mT
- Wideband sensing: DC to 250kHz
- Very short response time (2µs)
- High linearity down to ±0.2% full scale
- Very low thermal drift
  - Offset drift (<5mV)
  - Sensitivity drift (<1%)
- Programmable output clamping levels
- Broken wire detection and diagnostics
- AEC-Q100 – Grade 0 automotive qualified
- RoHS compliant
- SIP4-VA package
- MSL-1

## 2. Application Examples

- High Voltage Traction Motor Inverter
- 48V Boost Recuperation Inverter
- DCDC Converter
- Smart Battery Junction Boxes
- Smart Fuse Overcurrent Detection

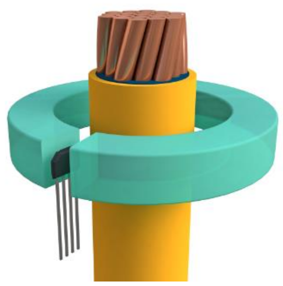

*Figure 1. Typical Current Sensing Application*

## 3. Description

The MLX91217 is a monolithic Hall-effect sensor which is sensitive to the flux density applied orthogonally to the IC surface. The sensor provides an analog output voltage proportional to the applied magnetic flux density.

The transfer characteristic of the MLX91217 is factory trimmed over temperature, and is programmable (offset, sensitivity, clamping, filtering) during end-of-line customer calibration. The output clamping levels and on-chip filtering are also programmable as a function of application needs. With the 250kHz bandwidth and fast response time, it is particularly adapted for high-speed applications such as inverters and converters where fast response time due to fast switching is required.

In a typical current sensing application, the sensor is used in combination with a ring shaped soft ferromagnetic core. This core is recommended to be laminated for high bandwidth applications. The MLX91217 is placed in a small air gap and the current conductor – a bus bar or a cable – is passed through the inner part of the ferromagnetic ring. On the one hand the ring concentrates and amplifies the magnetic flux seen by the sensor IC, and at the same time it attenuates external magnetic field disturbances.

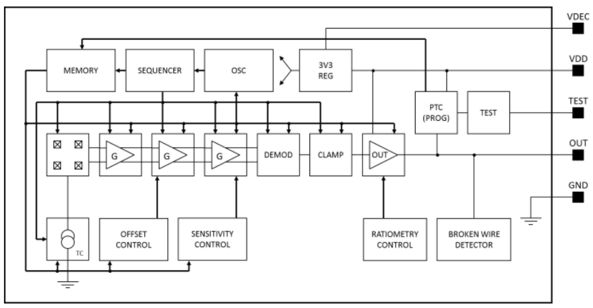


*Figure 2. General Block Diagram*

## Contents

# 4. Ordering Information

| Product | Temperature | Package | Option Code | Polarity | Packing Form | Typical Sensitivity |
|---|---|---|---|---|---|---|
| MLX91217 | L | VA | ACA – 000 | Direct | BU/CR | 10mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 001 | Direct | BU/CR | 15 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 002[1] | Direct | BU/CR | 17 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 003 | Direct | BU/CR | 9 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACY – 003 | Direct | RE | 9 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 004 | Direct | BU/CR | 7 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 005 | Direct | BU/CR | 13 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACT – 005 | Direct | RE | 13 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 006 | Direct | BU/CR | 29 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACJ – 008 | Inverse | RE | 13 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACZ – 008 | Inverse | RE | 13 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACA – 009 | Direct | BU/CR | 5 mV/mT (prog: 5..150mV/mT) |
| MLX91217 | L | VA | ACT – 009 | Direct | RE | 5 mV/mT (prog: 5..150mV/mT) |

*Table 1: Available ordering codes.*

[1] MLX91217-LVA-ACA-002 : customized sensitivity drift, VOQ = 1V

***Legend:***

| | | |
|---|---|---|
| Temperature Code: | **L** | from -40°C to 150°C ambient temperature |
| Package Code: | **VA** | SIP4-VA package, refer to *Chapter 17* for detailed drawings |
| Option Code: | **ACx-000** | for factory trimmed sensitivity 10mV/mT; |
| | **ACx-001** | for factory trimmed sensitivity 15mV/mT; |
| | **ACx-002**[1] | for factory trimmed sensitivity 17mV/mT; |
| | **ACx-003** | for factory trimmed sensitivity 9mV/mT; |
| | **ACx-004** | for factory trimmed sensitivity 7mV/mT; |
| | **ACx-005** | for factory trimmed sensitivity 13mV/mT; |
| | **ACx-006** | for factory trimmed sensitivity 29mV/mT; |
| | **ACx-008** | for factory trimmed sensitivity 13mV/mT, with inverted polarity; |
| | **ACx-009** | for factory trimmed sensitivity 5mV/mT |
| | **ACA-xxx** | default straight leads *(see chapter 17)* |
| | **ACR-xxx** | for Trim and Form shape: 90° 2x2x91.3 (h=5.34mm) Bending-STD2 *(see chapter 17)* |
| | **ACS-xxx** | for Trim and Form shape: 90° 2x2x91.3 (h=3.7mm) Bending-STD3 *(see chapter 17)* |
| | **ACT-xxx** | for Trim and Form shape: 90° 2x2x91.8 (h=1.68mm) Bending-STD4 *(see chapter 17)* |
| | **ACJ-xxx** | for Trim and Form shape: THT 2.54mm pitch *(see chapter 17)* |
| | **ACY-xxx** | for Trim and Form shape: SMD style TFZT *(see chapter 17)* |
| | **ACZ-xxx** | for Trim and Form shape: SMD style TFT4K1 *(see chapter 17)* |
| Packing Form: | **BU** | for Bulk, |
| | **CR** | for Carton Reel - Radial taping – available for straight leads only |
| | **CA** | for Carton Reel – Ammopack – available for straight leads only |
| | **RE** | for Plastic Reel – available for selected Trim & Form options only |
| Ordering Example: | "**MLX91217LVA-ACA-005-CR**"<br>MLX91217 Conventional Hall current sensor in SIP4 VA package, temperature range -40°C to 150°C. Sensitivity 13mV/mT. Parts delivered in Carton Reel (Radial Taping) | |

Melexis is continuously expanding its portfolio to serve our customer's needs. Please contact your local sales representative in case your desired ordering code is not part of the above table.

## 5. Functional Diagram

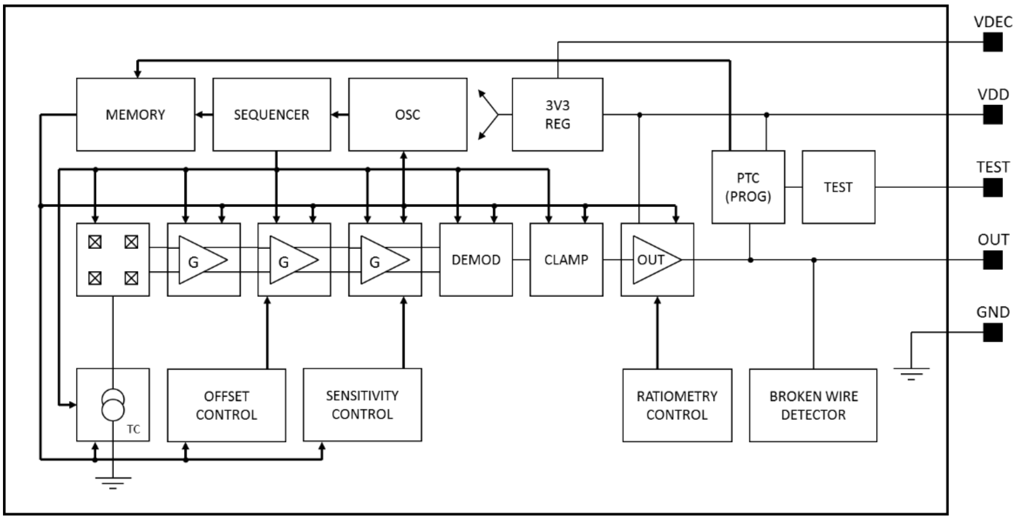


*Figure 3: Block Diagram of the MLX91217:*

## 6. Glossary of Terms

| Terms | Definition |
|---|---|
| TC | Temperature Coefficient |
| FS | Full Scale, output referred. Corresponds to 2V excursion around 2.5V VOQ point |
| T, mT | Tesla, milliTesla = units for the magnetic flux density |
| G | Gauss = unit for the magnetic flux density [1mT = 10G] |
| PTC | Programming Through Connector |
| IMC | Integrated Magnetic Concentrator (IMC-Hall®) |
| FS | Full scale. If FS=2000mV, 0.4%FS = 8mV |

*Table 2: Glossary of Terms*

# 7. Pin Definitions and Descriptions

Note: MLX91217 is pin-to-pin compatible with MLX91209.

| Pin # | Name | Type | Description |
|---|---|---|---|
| 1 | VDD | Supply | Supply Voltage |
| 2 | OUT | Analog | Current Sensor Output |
| 3 | TEST | Digital | Test and Factory Calibration |
| 4 | GND | Ground | Supply Voltage |

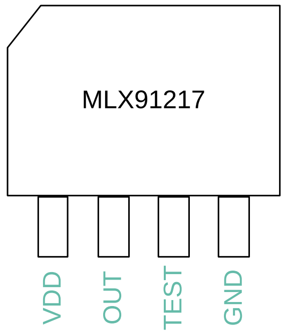


*Table 3: Pin definitions and descriptions*

For optimal EMC results, it is recommended to connect the TEST pin to the Ground (see section 13).

# 8. Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Positive Supply Voltage (overvoltage) | $V_{DD}$ | +10 | V |
| Reverse Voltage Protection | $VS_{REV}$ | -0.3 | V |
| Positive Output Voltage | $V_{OUT}$ | +10 | V |
| Output Current | $I_{OUT}$ | ±70 | mA |
| Reverse Output Voltage | $VO_{REV}$ | -0.3 | V |
| Reverse Output Current | $IO_{REV}$ | -50 | mA |
| Operating Ambient Temperature Range | $T_A$ | -40 to +150 | °C |
| Maximum Junction Temperature | $T_{j,max}$ | -55 to +155 | °C |
| Package Thermal Resistance *(junction-to-ambient)* $\theta_{ja}$ *is defined according JEDEC 1s0p board* | $\theta_{ja}$ | 205 | °C/W |
| Storage Temperature Range | $T_S$ | -55 to +165 | °C |
| Magnetic Flux Density | $B_{MAX}$ | ±3 | T |
| ESD – Human Body Model | $ESD_{HBM}$ | 2 | kV |

*Table 4: Absolute maximum ratings*

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum-rated conditions for extended periods of time may affect device reliability.

# 9. General Electrical Specifications

Operating Parameters $T_A$ = -40 to 150°C, $V_{DD}$ = 5V±10%, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Nominal Supply Voltage | $V_{DD}$ | | 4.5 | 5 | 5.5 | V |
| Supply | $I_{DD}$ | No $R_{load}$<br>LOW_POWER_MODE=0[2]<br>LOW_POWER_MODE=1 | | <br>12.5<br>10 | <br>15<br>13 | <br>mA<br>mA |
| Output Impedance | $R_{OUT}$ | Vout = 50% Vdd | | 1 | 5 | Ω |
| Output Capacitive Load | $C_L$ | OUT_MODE=0<br>OUT_MODE=1 | 1<br>10 | | 10<br>47 | nF<br>nF |
| Output Resistive Load | $R_{Load}$ | Output resistive load for high linearity and diagnostic band. | 10 | 25 | 200 | kΩ |
| Output Short Circuit Current | $I_{SHORT}$ | Output shorted permanent to VDD.<br>Output shorted permanent to GND. | | Not Destroyed<br>Not Destroyed | | |
| Linear Output Range | $VO_{LIN}$ | pull-down ≥ 10 kΩ | 10 | | 90 | %Vdd |
| Diagnostic Band[3] | DIAG | $R_L$ ≥ 10kΩ, $R_L$ ≤ 200 kΩ, $V_{DD}$ =5V<br>DIAG_LEVEL = 0<br>DIAG_LEVEL = 1 | <br>0<br>96 | | <br>4<br>100 | <br>%Vdd<br>%Vdd |
| BrokenGND Output Level[3] | | $R_L$ ≥ 10kΩ, $V_{DD}$ = 5V | 96 | | 100 | %Vdd |
| BrokenVDD Output Level[3] | | $R_L$ ≥ 10kΩ, $V_{DD}$ = 5V | 0 | | 4 | %Vdd |
| Under-voltage detection[3] | $V_{DD\_UVD}$ | Detected Voltage (Low to High) | 4.0 | | 4.5 | V |
| | $V_{DD\_UVH}$ | Hysteresis | 0.01 | | 0.2 | V |
| Over-voltage detection 1[3] | $V_{DD\_OVD1}$ | Detected Voltage (Low to High) | 6.7 | | 7.4 | V |
| | $V_{DD\_OVH1}$ | Hysteresis | 0.37 | | 0.66 | V |
| Over-voltage detection 2[3] | $V_{DD\_OVD2}$ | Detected Voltage (Low to High) | 8.3 | | 9.5 | V |
| | $V_{DD\_OVH2}$ | Hysteresis | 0.2 | | 0.8 | V |
| Clamped Output Level | Clamp_lo0 | CLAMP_LEVEL=0 | 5 | 6 | 7 | %Vdd |
| | Clamp_hi0 | CLAMP_LEVEL=0 | 92 | 93 | 94 | %Vdd |
| | Clamp_lo1 | CLAMP_LEVEL=1 | 5 | 6 | 7 | %Vdd |
| | Clamp_hi1 | CLAMP_LEVEL=1 | 93 | 94 | 95 | %Vdd |
| | Clamp_lo2 | CLAMP_LEVEL=2 | 7 | 8 | 9 | %Vdd |
| | Clamp_hi2 | CLAMP_LEVEL=2 | 91 | 92 | 93 | %Vdd |
| | Clamp_lo3 | CLAMP_LEVEL=3 | 9 | 10 | 11 | %Vdd |
| | Clamp_hi3 | CLAMP_LEVEL=3 | 89 | 90 | 91 | %Vdd |

*Table 5: General electrical parameters*

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[2] *Default Factory Calibration*
[3] *Please refer to section 12 for more information on self-diagnostic modes.*

# 10. Magnetic specification

Operating Parameters $T_A$ = -40 to 150°C, $V_{DD}$ = 5V±10%, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Operational Magnetic Field Range | $B_{OP}$ | | ±15 | ±130 | ±450 | mT |
| Linearity Error | NL | $V_{OUT}$ in [10%$V_{DD}$, 90%$V_{DD}$], $T_A$ = 25°C<br>LOW_POWER_MODE=0<br>LOW_POWER_MODE=1 | | | ±0.4<br>±0.2 | %FS<br>%FS |
| Programmable Sensitivity[4] | S | | 5 | 15 | 150 | mV/mT |
| Sensitivity programming Resolution | $S_{RES}$ | B = $B_{OP}$ | | 0.1 | | % |

*Table 6: Magnetic specification*

# 11. Analog output specification

## 11.1. Accuracy specifications

Operating Parameters $T_A$ = -40 to 150°C, $V_{DD}$ = 5V±10%, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Thermal Offset Drift | $\Delta^T V_{OQ}$ | $T_A$ = -40 to 125°C<br>$T_A$ = -40 to 150°C | | | ±5<br>±8 | mV<br>mV |
| Thermal Sensitivity Drift[5] | $\Delta^T S$ | $T_A$ = -40 to 125°C<br>$T_A$ = -40 to 150°C | | | ±1.0<br>±1.2 | %S<br>%S |
| RMS Output Noise | $N_{RMS}$ | Values for 50mV/mT sensitivity<br>Scales with typical sensitivity of Table 1<br>NOISE_FILTER=0<br>NOISE_FILTER=1<br>NOISE_FILTER=2<br>NOISE_FILTER=3 | | 10<br>7<br>5<br>3 | | $mV_{RMS}$<br>$mV_{RMS}$<br>$mV_{RMS}$<br>$mV_{RMS}$ |
| $V_{OQ}$ Ratiometry | $\Delta^R V_{OQ}$ | $V_{DD}$ = 5V±5%, (for all option codes)<br>$V_{OQ}$ = 20%$V_{DD}$ MLX91217LVA-ACA-002)<br>$V_{OQ}$ = 50%$V_{DD}$ – (all other option codes) | | | ±0.4<br>±0.4 | %$V_{OQ}$<br>%$V_{OQ}$ |
| Sensitivity Ratiometry | $\Delta^R S$ | $V_{DD}$ = 5V±5%, B = $B_{OP}$ | | | ±0.4 | %S |
| Clamped output accuracy | $CL_{ACC}$ | | | | ±1 | %Vdd |

*Table 7: Accuracy specifications – analog parameters*

[4] Changing the sensitivity more than +/-200% versus factory programmed sensitivity may cause an increase of the thermal offset drift.
[5] Except MLX91217-LVA-ACA-002

The accuracy specifications are defined for the factory calibrated sensitivity. The achievable accuracy is dependent on the user's end-of-line calibration. Resolution for offset and offset drift calibration is better than 0.02%$V_{DD}$. Trimming capability is higher than measurement accuracy. End-user calibration can therefore increase the accuracy of the system.

## 11.2. Timing specifications

Operating Parameters $T_A$ = -40 to 150°C, Vdd = 5V±10%, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Refresh rate | Trr | | 0.8 | 1 | 2 | µs |
| Step Response Time | $T_R$ | $C_L$=10nF<br>NOISE_FILTER=0, LOW_POWER_MODE=0<br>NOISE_FILTER=0, LOW_POWER_MODE=1<br>NOISE_FILTER=1, LOW_POWER_MODE=0<br>NOISE_FILTER=1, LOW_POWER_MODE=1<br>NOISE_FILTER=2, LOW_POWER_MODE=0<br>NOISE_FILTER=2, LOW_POWER_MODE=1<br>NOISE_FILTER=3, LOW_POWER_MODE=0<br>NOISE_FILTER=3, LOW_POWER_MODE=1 | | <br>2<br>3<br>3<br>5<br>4<br>6<br>8<br>10 | <br>3<br>4<br>4<br>6<br>5<br>7<br>9<br>11 | <br>µs<br>µs<br>µs<br>µs<br>µs<br>µs<br>µs<br>µs |
| Power on Delay | $T_{POD}$ | Vout =100% of F.S. | | | 1 | ms |
| Ratiometry Cut-off Frequency | $F_{RAT}$ | | | 250 | | Hz |

*Table 8: Timing specifications of the high-speed analog output*

# 12. Self-diagnostic

MLX91217 provides several self-diagnostic features, which prevent the IC from providing erroneous output signal in case of internal or external failure modes.

| Error | Effect on Output | Remarks |
|---|---|---|
| Calibration data CRC Error | DIAG_LEVEL=0 → active pull-down to GND<br>DIAG_LEVEL=1 → active pull-up to VDD | at power up and in normal mode |
| Power-On Delay | Pull-down to GND | 1ms max followed by settling |
| Over-voltage Mode 1 | Active pull-down to GND | |
| Over-voltage Mode 2 | DIAG_LEVEL=0 → active pull-down to GND<br>DIAG_LEVEL=1 → active pull-up to VDD | |
| Under-voltage Mode | DIAG_LEVEL=0 → active pull-down to GND<br>DIAG_LEVEL=1 → active pull-up to VDD | Valid with enabled ratiometry<br>(Default: RATIOEN = 1) |
| Broken OUT | Active pull-down to GND | |
| Broken GND | Output pulled up to VDD | IC is switched off |
| Broken VDD | Output pulled down to GND | IC is switched off |

*Table 9: Description of the self-diagnostic modes in MLX91217*

## 13. Programmable Parameters

Customers can re-program the parameters described in the table below by using the PTC-04 hardware and the Product Specific Functions (PSF) libraries provided by Melexis. We recommend using the latest version of the PSF and the firmware, with a communication speed of 10kbps (maximum output capacitor of 47nF). Please contact your sales representative to get access to Melexis SoftDist platform and download the latest software.

| Parameter | Bits | Factory Setting | Function |
|---|---|---|---|
| ROUGHGAIN | 3 | Trimmed | Rough gain trimming |
| FINEGAIN | 10 | Trimmed | Fine gain trimming |
| VOQ | 12 | Trimmed | Offset trimming |
| OUT_MODE | 1 | 0 | 0: low capacitive load (see section 14)<br>1: high capacitive load (see section 14) |
| DIAG_LEVEL | 1 | 0 | 0: in diagnostic, output is pulled down to GND<br>1: in diagnostic, output is pulled up to Vdd |
| LOW_POWER_MODE | 1 | 0 | 0: normal mode<br>1: low power mode with slower response time. **Not recommended with RG=0** |
| CLAMP_LEVEL | 2 | 1 | Select clamping level (%VDD)<br>0: 6%/93%,<br>1: 6%/94%,<br>2: 8%/92%,<br>3: 10%/90% |
| NOISE FILTER | 2 | 0/1[6] | 0: Noise filter: deactivated<br>1: Noise filter: 120kHz<br>2: Noise filter: 60kHz<br>3: Noise filter: 15kHz |
| CSTID | 17 | N/A | Customer ID |

*Table 10: Default settings*

## 14. Recommended Application Diagram

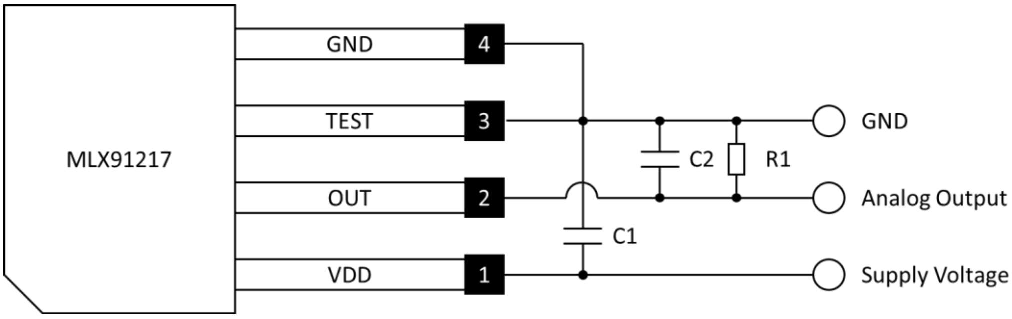



*Figure 4: Application Diagram with external Pull-Down resistance*

| Part | Description | Value | Unit |
|---|---|---|---|
| C1 | Supply capacitor, EMI, ESD | 100 | nF |
| C2 | Decoupling, EMI, ESD, OUT_MODE=0 | 1-10 | nF |
| | Decoupling, EMI, ESD, OUT_MODE=1 | 8-47 | nF |
| R1 | Pull down resistor | 10-200 | kΩ |

*Table 11: Resistor and capacitor values*

## 15. Standard Information

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to standards in place in Semiconductor industry.

**Reflow Soldering SMD's (Surface Mount Devices)**

- IPC/JEDEC J-STD-020
  Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
  (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113
  Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
  (reflow profiles according to table 2)

**Wave Soldering SMD's (Surface Mount Devices) and THD's (Through Hole Devices)**

- EN60749-20
  Resistance of plastic- encapsulated SMD's to combined effect of moisture and soldering heat
- EIA/JEDEC JESD22-B106 and EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

**Iron Soldering THD's (Through Hole Devices)**

- EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

**Solderability SMD's (Surface Mount Devices) and THD's (Through Hole Devices)**

- EIA/JEDEC JESD22-B102 and EN60749-21
  Solderability

For further details about test method references and for compliance verification of selected soldering method for product integration, Melexis recommends reviewing on our web site the General Guidelines soldering recommendation. For all soldering technologies deviating from the one mentioned in above document (regarding peak temperature, temperature gradient, temperature profile etc), additional classification and qualification tests have to be agreed upon with Melexis.

For package technology embedding trim and form post-delivery capability, Melexis recommends to consult the dedicated trim&form recommendation application note: lead trimming and forming recommendations.

Melexis is contributing to global environmental conservation by promoting **lead free** solutions. For more information on qualifications of **RoHS** compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website: http://www.melexis.com/en/quality-environment

## 16. ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

# 17. Packaging Information

Tolerances are not guaranteed when parts are delivered in bulk form (ESD bag).

## 17.1. Sensor active measurement direction

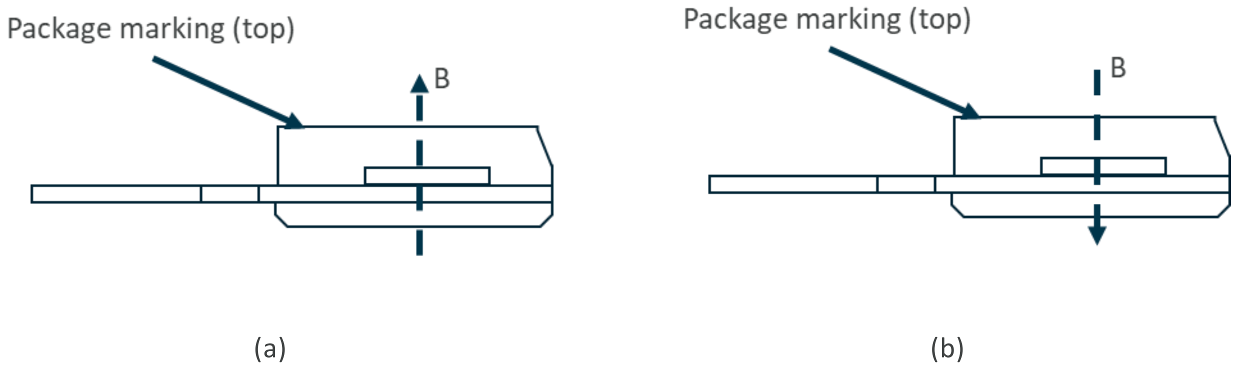



*Figure 5. VA/SIP 4L Package, with sensor's active measurement direction in (a) direct and (b) inverse polarity configurations.*

## 17.2. Package Marking & Hall Plate Position

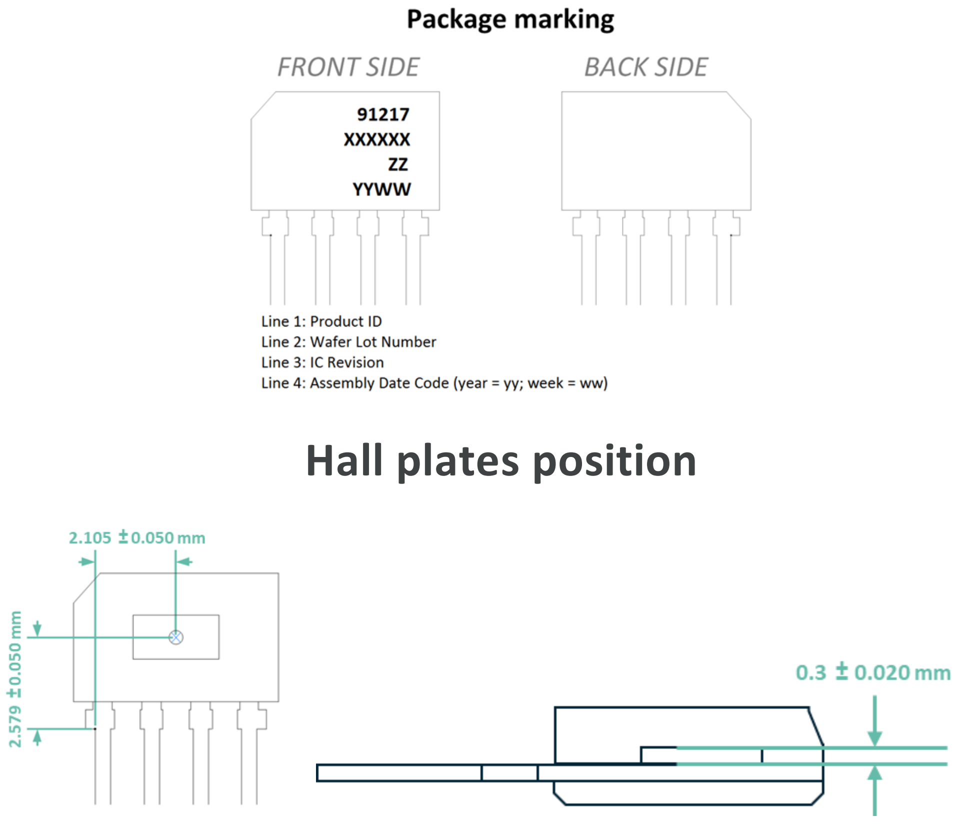
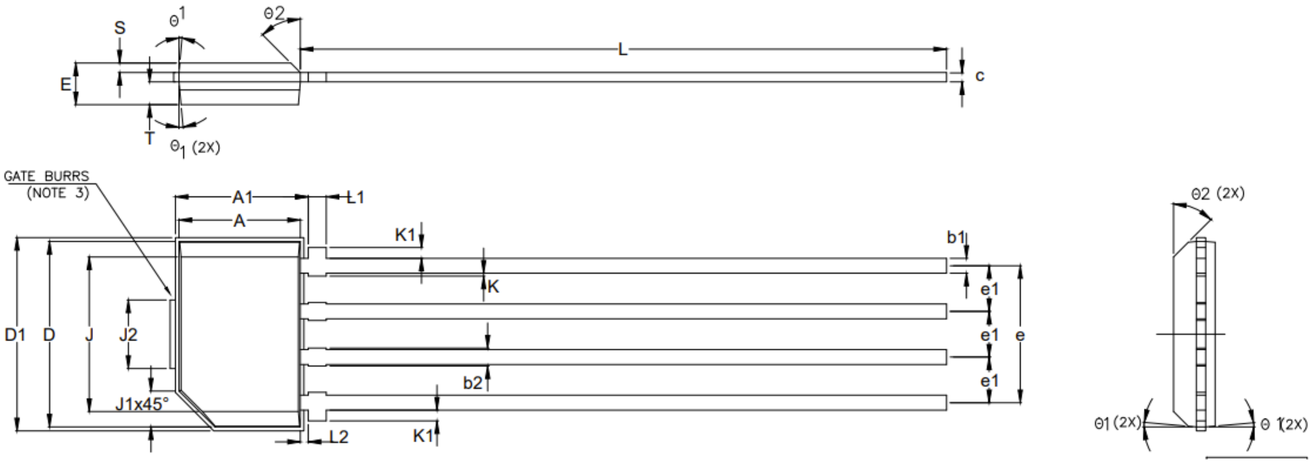
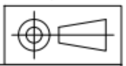



*Figure 6. VA/SIP 4L (single in-line package) / 18mm lead length - Package Information and Hall plates position.*

## 17.3. VA Straight leads (ACA-xxx)

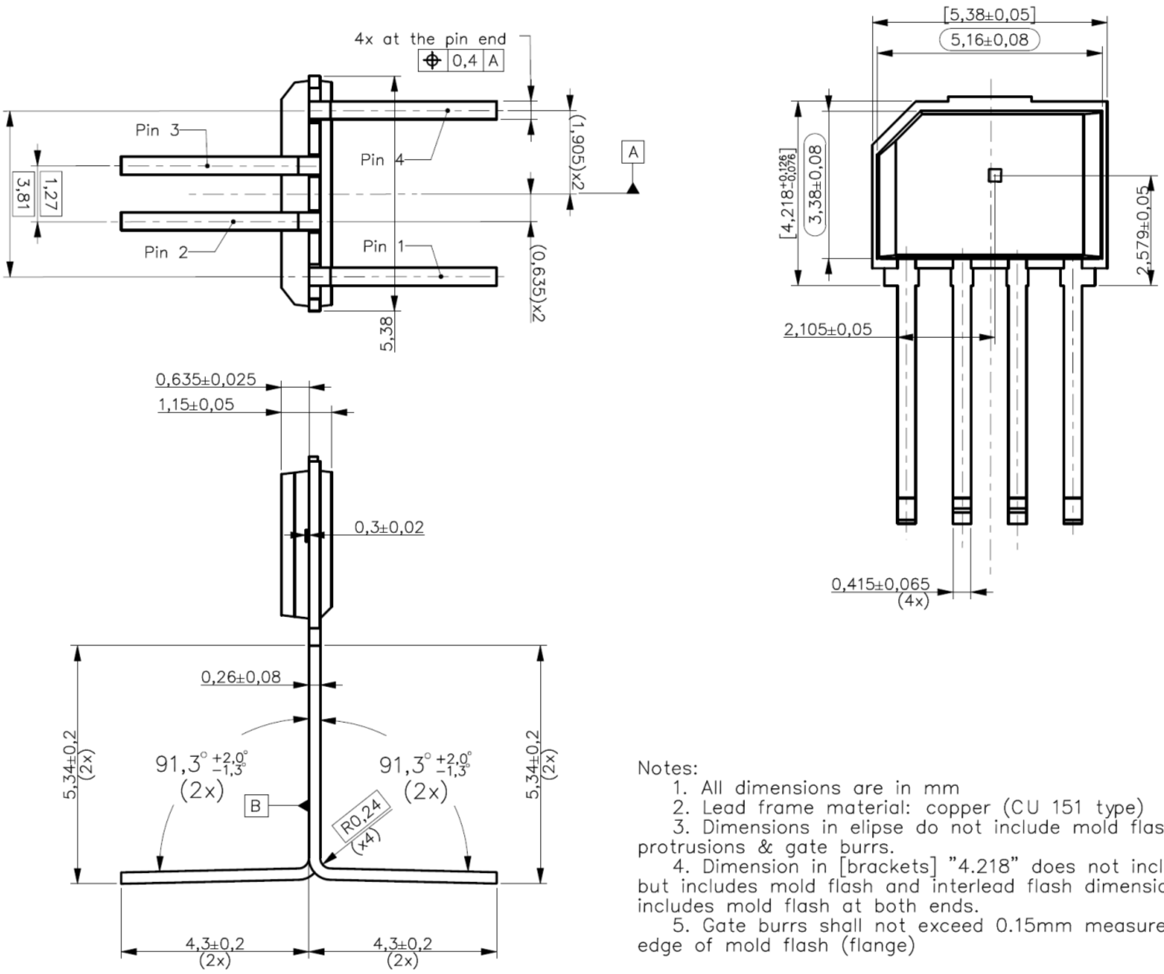



Note:
1. DIMENSIONS "A" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS AND GATE BURRS.
2. DIMENSIONS "A1" DOES NOT INCLUDE GATE BURRS BUT INCLUDES MOLD FLASH AT BOTH ENDS.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.15 mm MEASURED FROM EDGE OF MOLD FLASH (FLANGE).
4. DIMENSION "D1" INCLUDES MOLD FLASH AT BOTH ENDS.
5. LEAD PLATING; MATTE TIN PLATING THICKNESS 7.62 – 15.42 um.



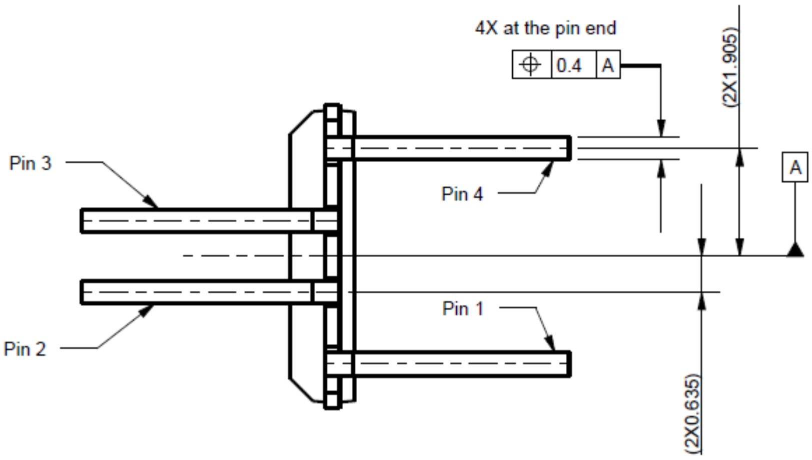
| SYMBOLS | DIMENSIONS IN MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 3.30 | 3.38 | 3.46 |
| A1 | 3.62 | 3.70 | 3.78 |
| D | 5.08 | 5.16 | 5.24 |
| D1 | 5.33 | 5.38 | 5.43 |
| E | 1.10 | --- | 1.20 |
| J | 4.10 | 4.30 | 4.50 |
| J1 | 1.00 REF | | |
| J2 | 1.906 REF | | |
| K | 0.00 | --- | 0.15 |
| K1 | 0.25 | 0.30 | 0.35 |
| L | 17.5 | 18.0 | 18.5 |
| L1 | 0.45 | 0.50 | 0.55 |
| L2 | 0.22 REF | | |
| S | 0.24 | --- | 0.29 |
| T | 0.61 | --- | 0.66 |
| b1 | 0.35 | --- | 0.48 |
| b2 | 0.40 | --- | 0.60 |
| c | 0.18 | --- | 0.34 |
| e | 3.745 | 3.81 | 3.875 |
| e1 | 1.205 | 1.27 | 1.335 |
| Θ1 | 5° REF | | |
| Θ2 | 45° REF | | |

## 17.4. Trim and form type: 90° 2x2x91.3 (h=5.34mm); Bending-STD2 (ACR-xxx)

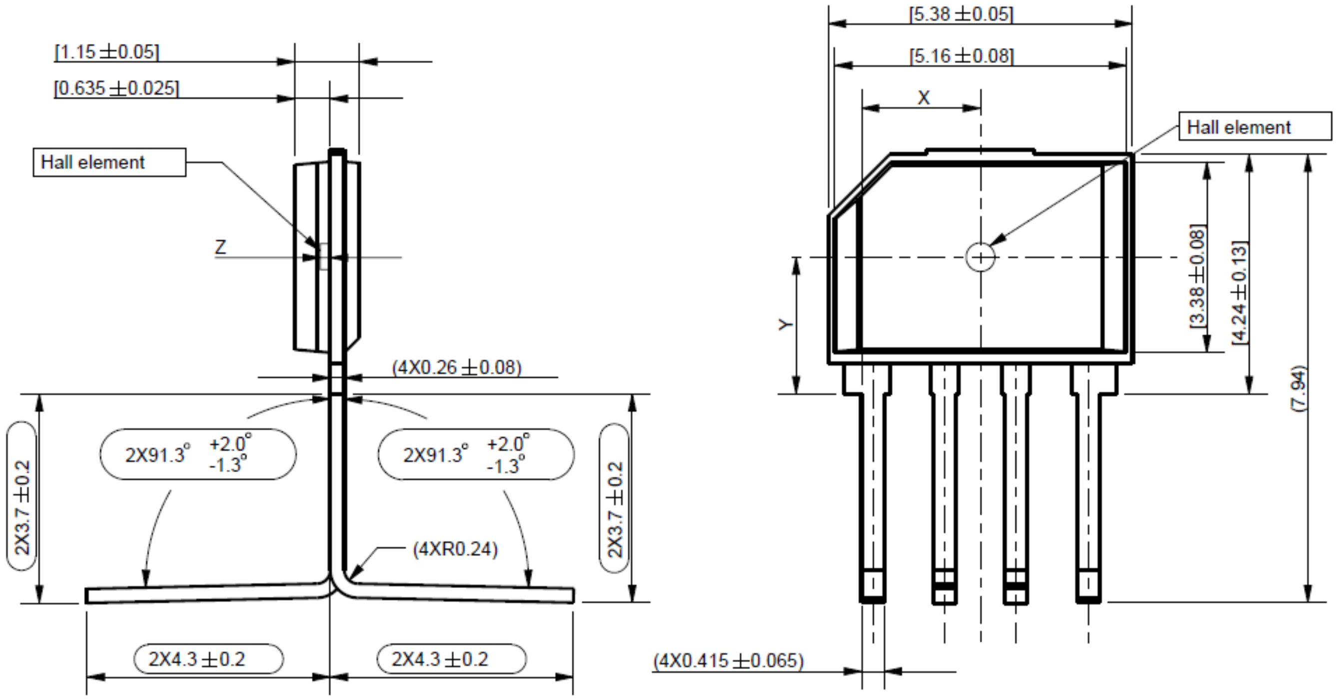



Notes:
1. All dimensions are in mm
2. Lead frame material: copper (CU 151 type)
3. Dimensions in elipse do not include mold flash protrusions & gate burrs.
4. Dimension in [brackets] "4.218" does not include gate burrs, but includes mold flash and interlead flash dimension "5.38" includes mold flash at both ends.
5. Gate burrs shall not exceed 0.15mm measured from edge of mold flash (flange)

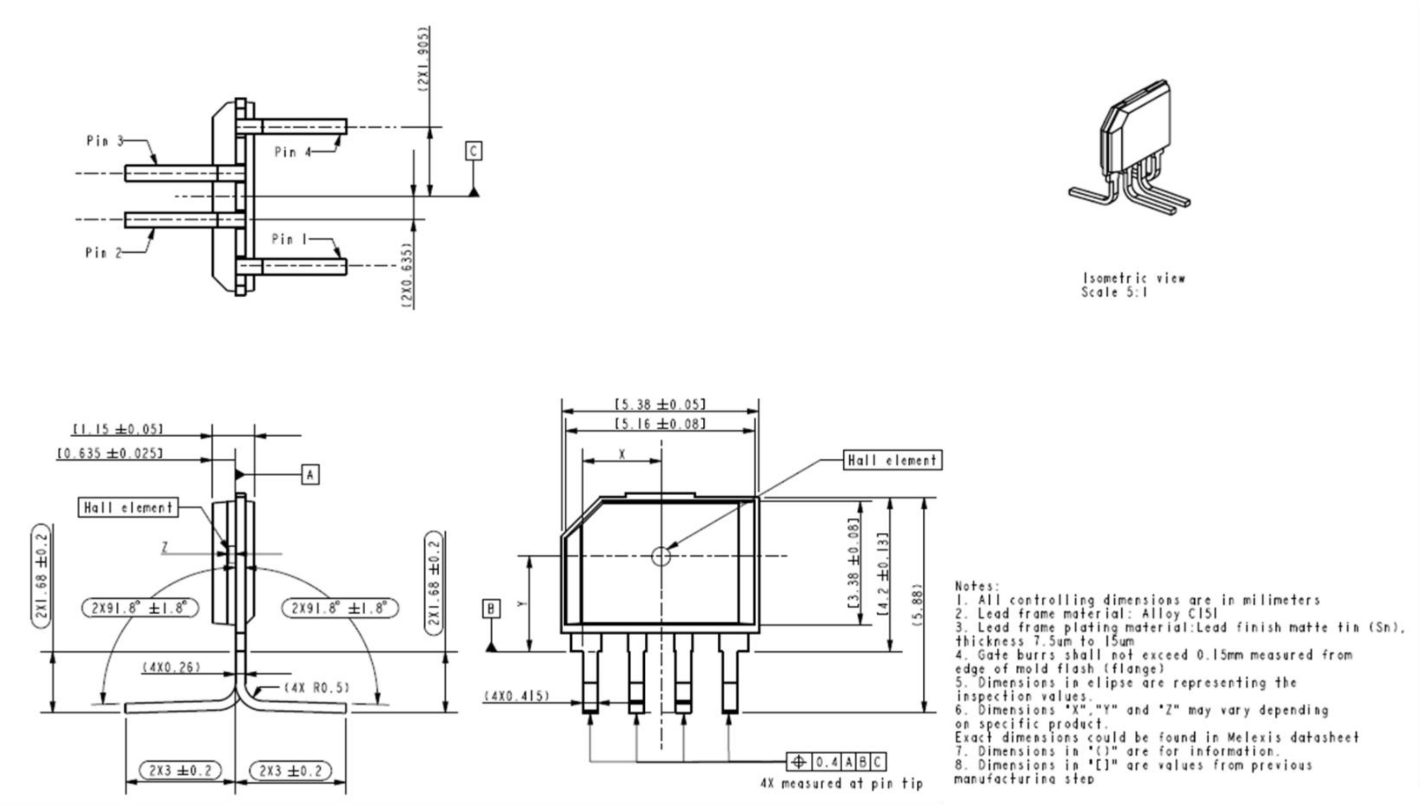
## 17.5. Trim and form type: 90° 2x2x91.3 (h=3.7mm); Bending-STD3 (ACS-xxx)



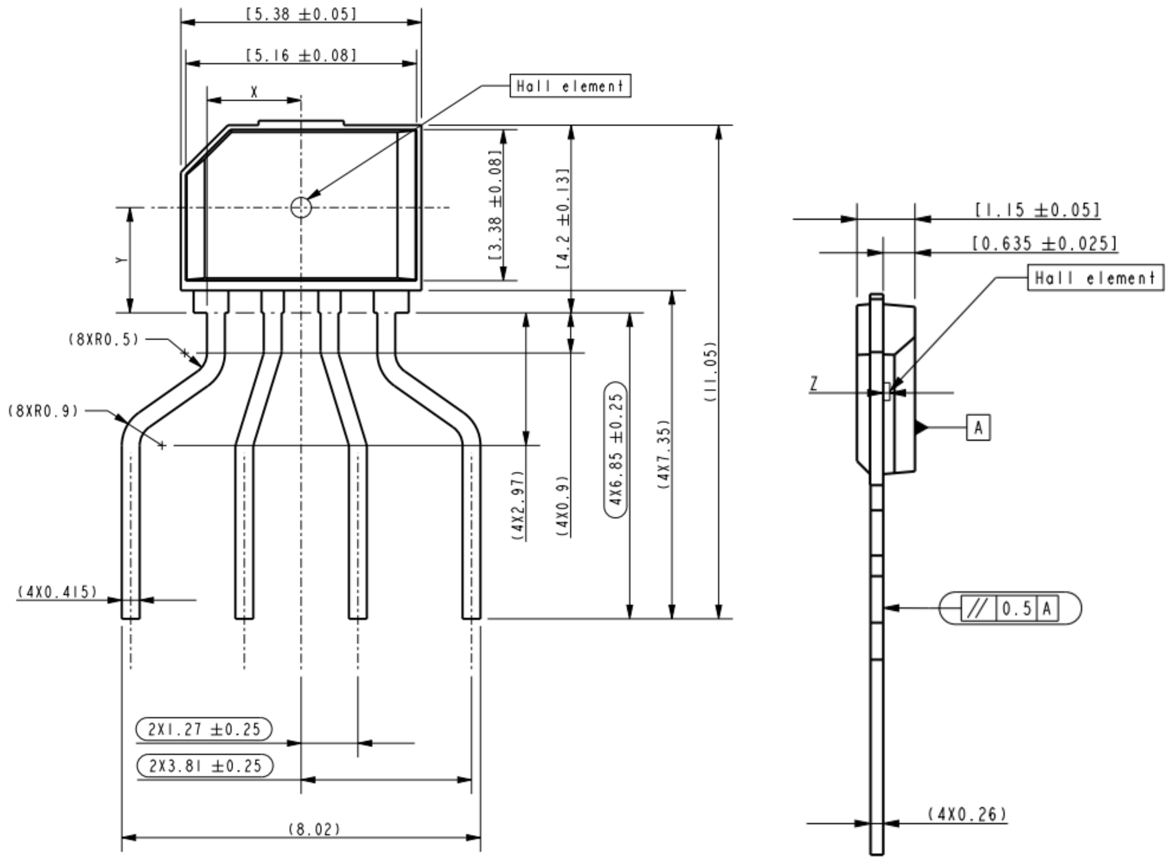

Notes:
1. All controlling dimensions are in milimeters
2. Lead frame material: Alloy C151
3. Lead frame plating material: Spot silver
4. Gate burrs shall not exceed 0.15mm measured from edge of mold flash (flange)
5. Dimensions in elipse are representing the inspection values.
6. Dimensions "X","Y" and "Z" may vary depending on specific product.
Exact dimensions could be found in Melexis datasheet
7. Dimensions in "()" are for information.
8. Dimensions in "[]" are values from previous manufacturing step



## 17.6. Trim and form type: 90° 2x2x91.8 (h=1.68mm); Bending-STD4 (ACT-xxx)

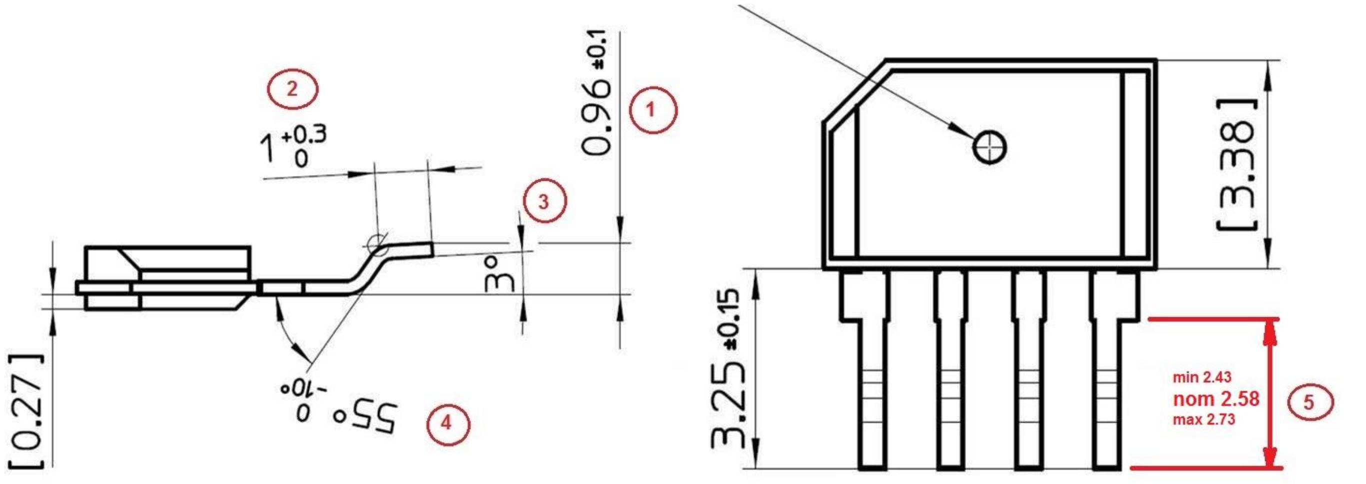


## 17.7. Trim and form type: THT 2.54mm pitch (ACJ-xxx)



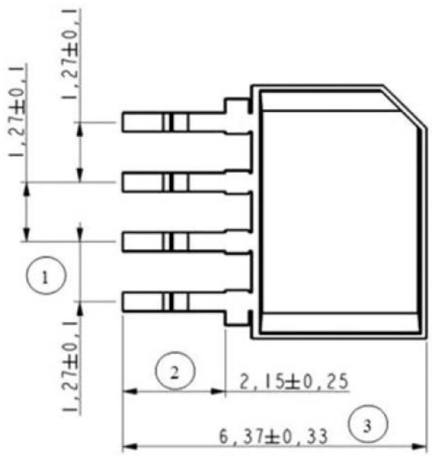

Notes:
1. All controlling dimensions are in milimeters
2. Lead frame material: Alloy C151
3. Lead frame plating material: Spot silver
4. Gate burrs shall not exceed 0.15mm measured from edge of mold flash (flange)
5. Dimensions in elipse are representing the inspection values.
6. Dimensions "X","Y" and "Z" may vary depending on specific product.
Exact dimensions could be found in Melexis datasheet
7. Dimensions in "()" are for information.
8. Dimensions in "[]" are values from previous manufacturing step

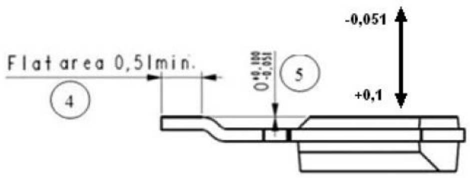
## 17.8. Trim and form type: SMD style TFZT (ACY-xxx)




| Parameter | | | | |
|---|---|---|---|---|
| Dim# 1 [mm] | Dim# 2 [mm] | Dim# 3 [deg] | Dime# 4 [deg] | Dime# 5 [mm] |
| 0.96 | 1 | 3 | 50 | 2.58 |
| ±0.1 | 0.3/-0 | ±1 | ±5 | ±0.15 |

## 17.9. Trim and form type: SMD style TFT4K1 (ACZ-xxx)




| Parameter | | | | |
|---|---|---|---|---|
| Dim# 1 [mm] | Dim# 2 [mm] | Dim# 3 [mm] | Dim# 4 [mm] | Dim# 5 [mm] |
| 1.27 +/- 0.10 | 2.15 +/- 0.25 | 6.37 +/- 0.33 | min. 0.51 | 0 -0.051/+0.10 |

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