

Main Function and Parameter:

- 600V,6A three-phase DC to AC inverter
- Low-Side MOSFET open-source output

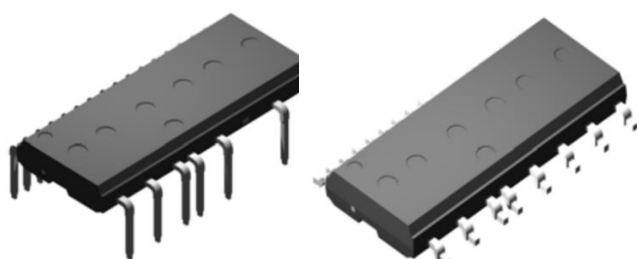
Application:

- Electric fan;
- Electrical tools;

Features:

- Signal high level valid, compatible with 3.3v and 5V MCU;
- Lower arm MOSFET source electrode output;
- Built-in bootstrap diode;
- Built-in straight through protection;
- Built-in undervoltage protection;
- Internal integrated temperature detection output;
- Resistant to high voltage 1500V;

Package



DIP23-FP

SOP23-FP

| Order codes | Package | Marking |
|----------------|----------|--------------|
| XZ06GCA60A1C-A | DIP23-FP | XZ6GCA60A1CA |
| XZ06GCA60A1D-A | SOP23-FP | XZ6GCA60A1DA |

Internal Block Diagram

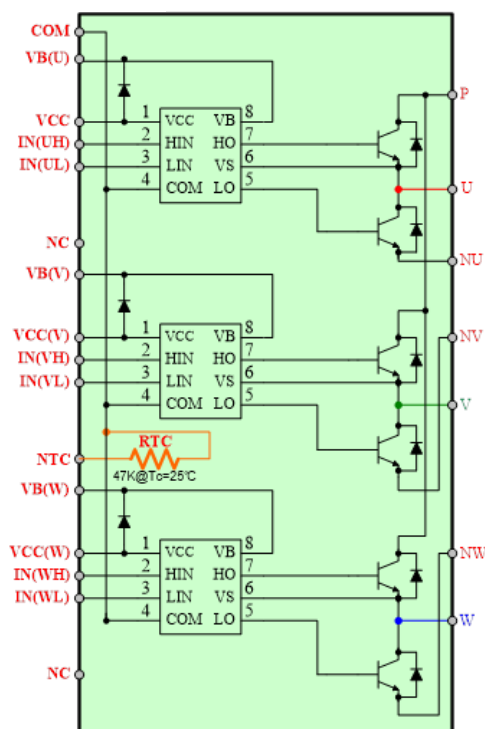


Fig 1: Internal Block Diagram

Pin Configuration

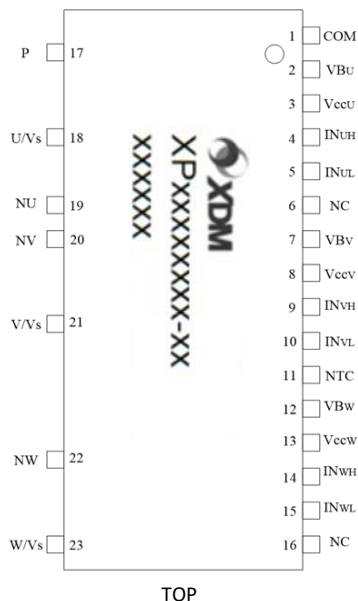


Fig 2: Pin Configuration

| Pin Number | Pin Name | Pin Description |
|------------|----------|--|
| COM | 1 | IC Common Supply Ground |
| VB(U) | 2 | Bias Voltage for U-Phase High-Side IGBT Driving |
| Vcc(U) | 3 | Bias Voltage for U-phase IC and Low-Side IGBT Driving |
| HIN(UH) | 4 | Signal Input for U-Phase High-Side |
| LIN(UL) | 5 | Signal Input for U-Phase Low-Side |
| NC | 6 | No Connection |
| VB(V) | 7 | Bias Voltage for V-Phase High-Side IGBT Driving |
| Vcc(V) | 8 | Bias Voltage for V-phase IC and Low-Side IGBT Driving |
| HIN(VH) | 9 | Signal Input for V-Phase High-Side |
| LIN(VL) | 10 | Signal Input for V-Phase Low-Side |
| NTC | 11 | NTC terminal |
| VB(W) | 12 | Bias Voltage for W-Phase High-Side IGBT Driving |
| Vcc(W) | 13 | Bias Voltage for W-phase IC and Low-Side IGBT Driving |
| HIN(WH) | 14 | Signal Input for W-Phase High-Side |
| LIN(WL) | 15 | Signal Input for W-Phase Low-Side |
| NC | 16 | No Connection |
| P | 17 | Positive DC-Link Input |
| U/Vs | 18 | Output for U Phase and Bias Voltage Ground for U Phase High Side Driving |
| NU | 19 | Negative DC-Link Input for U Phase |
| NV | 20 | Negative DC-Link Input for V Phase |
| V/Vs | 21 | Output for V Phase and Bias Voltage Ground for U Phase High Side Driving |
| NW | 22 | Negative DC-Link Input for W Phase |
| W/Vs | 23 | Output for W Phase and Bias Voltage Ground for U Phase High Side Driving |

Fig 3: Pin function

Absolute Maximum Ratings (T_j= 25° C, Unless Otherwise Specified)

| Symbol | Parameter | Condition | Ratings | Units |
|---------------------------|-------------------------------------|--|---------------------------|-------|
| Inverter Part | | | | |
| V _P | Supply Voltage | Applied between P- NU, NV, NW | 450 | V |
| V _{P(Surge)} | Supply Voltage (Surge) | Applied between P- NU, NV, NW | 500 | V |
| V _{CEs} | Collector-emitter Voltage | | 600 | V |
| I _C | Each IGBT Collector Current | T _C =25°C (T _C refer to Fig:3) | 6 | A |
| I _{CM} | Each IGBT Collector Current (Peak) | T _C =25°C, less than 1ms | 12 | A |
| P _C | Collector Dissipation | T _C =25°C, Per One Chip | 56 | W |
| T _j | Operating Junction Temperature | (NOTE 1) | -40~+150 | °C |
| Control Part | | | | |
| V _{CC} | Control Supply Voltage | Applied between V _{CC} and COM | 20 | V |
| V _{BS} | High-side Bias Voltage | Applied between VB and VS | 18 | V |
| V _{IN} | Input Signal Voltage | Applied between V _{IN} and COM | -0.3~V _{CC} +0.3 | V |
| Total System | | | | |
| T _j | Operating Junction Temperature | | -20~125 | °C |
| T _C | Surface Temperature | T _j ≤150°C (Note 1 & 2) | -20~100 | °C |
| T _{STG} | Storage Temperature | T _C = 25°C | -40~125 | °C |
| V _{ISO} | Isolation Voltage | 60Hz, Sinusoidal, AC 1 min, between pins and heat-sink plate | 1500 | V |
| Thermal Resistance | | | | |
| R _{th(j-c)} | Junction to Case Thermal resistance | For Each MOSFET | 2.7 | °C/W |

Note 1 : Though power IC's max. junction temperature is 150 oC , to ensure safe operation of the IPM, the junction temperature should be limited to T_j (av) ≤125oC (Surface Temperature @TC ≤100°C).

Note 2 : For the measurement point of the shell temperature(T_C), please refer figure 3.

RECOMMAMD OPERATING CONDITIONS

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|--------------------------------|-------------------------------|----------------------------------|------|-----|------|------|
| V_{PN} | Supply Voltage | Applied between P-NU,NV,NW | 0 | 300 | 400 | V |
| V_{CC} | Control Supply Voltage | Applied between V_{CC} and COM | 13.5 | 15 | 16.5 | V |
| V_{BS} | High-side Supply Bias Voltage | Applied between V_B and V_S | 13.5 | 15 | 16.5 | V |
| dv_{CC}/dt , dv_{BS}/dt | Control power fluctuation | | -1 | - | 1 | V/us |
| $V_{IN(ON)}$ | Input ON threshold Voltage | Applied between V_{IN} and COM | 3.0 | - | - | V |
| $V_{IN(OFF)}$ | Input OFF threshold Voltage | | 0 | - | 0.8 | V |
| F_{PWM} | PWM switching Frequency | $T_j \leq 150^\circ C$ | - | - | 20 | KHz |
| COM | COM Voltage fluctuation | Between COM and NU,NV,NW | -5 | - | 5 | V |

Electrical Characteristics (T_J= 25°C, Unless Otherwise Specified)

Inverter Part

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|---------------|--------------------------------------|--|-----|------|-----|------|
| $V_{CE(sat)}$ | Collector-Emitter saturation voltage | $V_{GE}=15V$, $I_C=6A$, $T_C=25^\circ C$ | - | 1.75 | 2.1 | V |
| V_F | FRD Forward Voltage | $I_F = 4A$ | - | 1.3 | 1.6 | V |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{CC}=400V$ $V_{GE}=\pm 15V$ $I_C=6A$ $R_G=10\Omega$ Inductive Load $T_{vj}=25^\circ C$ | - | 12 | - | ns |
| t_r | Turn-on Rise Time | | - | 6 | - | ns |
| $t_{d(off)}$ | Turn-off Delay Time | | - | 14 | - | ns |
| t_f | Turn-off Fall Time | | - | 154 | - | ns |
| E_{on} | Turn-on Switching Loss | | - | 91 | - | uJ |
| E_{off} | Turn-off Switching Loss | | - | 95 | - | uJ |
| E_{ts} | Total Switching Loss | | - | 186 | - | uJ |
| I_{CES} | Zero gate voltage collector current | $V_{CE}=600V$, $V_{GE}=0V$ (Note 3) | - | 500 | - | uA |

Note 3 : Storage in harsh humidity environment or after anti-humidity ability test like THT 1000hr , the I_{CES} peak value might be up to over 1mA in 600V condition.

Electrical Characteristics (T_J= 25°C, Unless Otherwise Specified)

Control Part

| Symbol | Parameter | Condition | | Min | Typ | Max | Unit |
|-------------------|---|---|--|-----|-----|------|------|
| I _{QCC} | Quiescent V _{CC} Supply Current | V _{CC} =15V V _{IN} =5V | Applied between V _{CC} and COM | - | - | 1500 | uA |
| I _{QB} | Quiescent V _{BS} Supply Current | V _{DB} =15V V _{IN} =5V | Applied between V _{B(U)} -U, V _{B(V)} -V, V _{B(W)} -W | - | - | 600 | uA |
| UV _{CCD} | Low-Side Under-Voltage Protection | V _{CC} Under-Voltage Protection Detection Level | | 7.6 | 8.4 | 9.2 | V |
| UV _{CCR} | | V _{CC} Under-Voltage Protection Reset Level | | 8.0 | 8.9 | 9.8 | V |
| UV _{BSD} | High-Side Under-Voltage Protection (Figure 4. & 5.) | V _{BS} Under-Voltage Protection Detection Level | | 7.6 | 8.4 | 9.2 | V |
| UV _{BSR} | | V _{BS} Under-Voltage Protection Reset Level | | 8.0 | 8.9 | 9.8 | V |
| V _{IH} | ON Threshold Voltage | Logic High Level, Applied between V _{IN} and COM | | 3.0 | - | - | V |
| V _{IL} | OFF Threshold Voltage | Logic Low Level, Applied between V _{IN} and COM | | - | - | 0.8 | V |

Bootstrap Diode Part

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|-----------------|-----------------------|--|-----|-----|-----|------|
| V _F | Forward Voltage | I _F = 4A | - | 1.3 | 1.6 | V |
| t _{rr} | Reverse recovery time | I _F =0.5A, I _R =1A, I _{RR} =0.25A | - | 22 | 35 | nS |

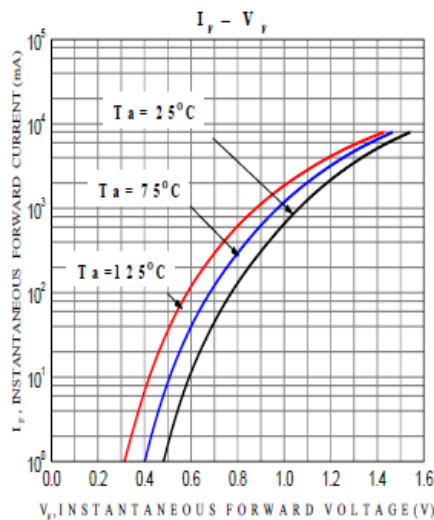


Figure 1. Forward Characteristic (typ.)

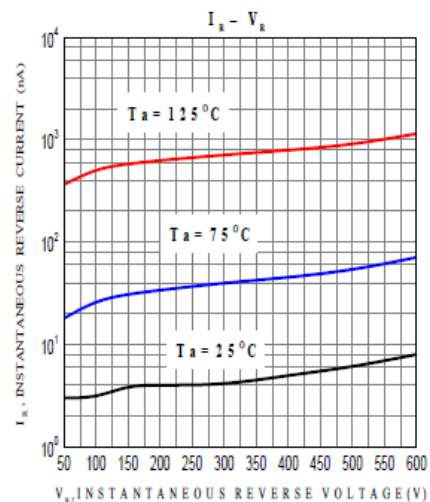


Figure 2. Reverse Characteristic (typ.)

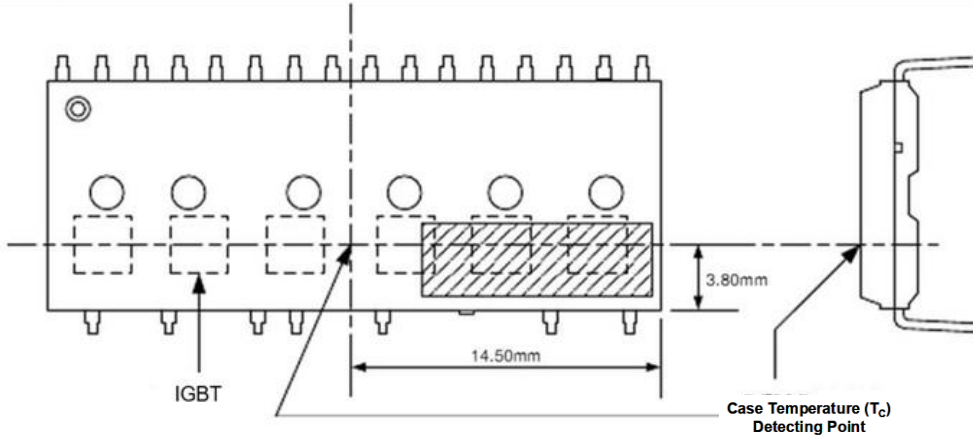


Fig 3: Case Temperature Measurement

Time Charts of Protective Function

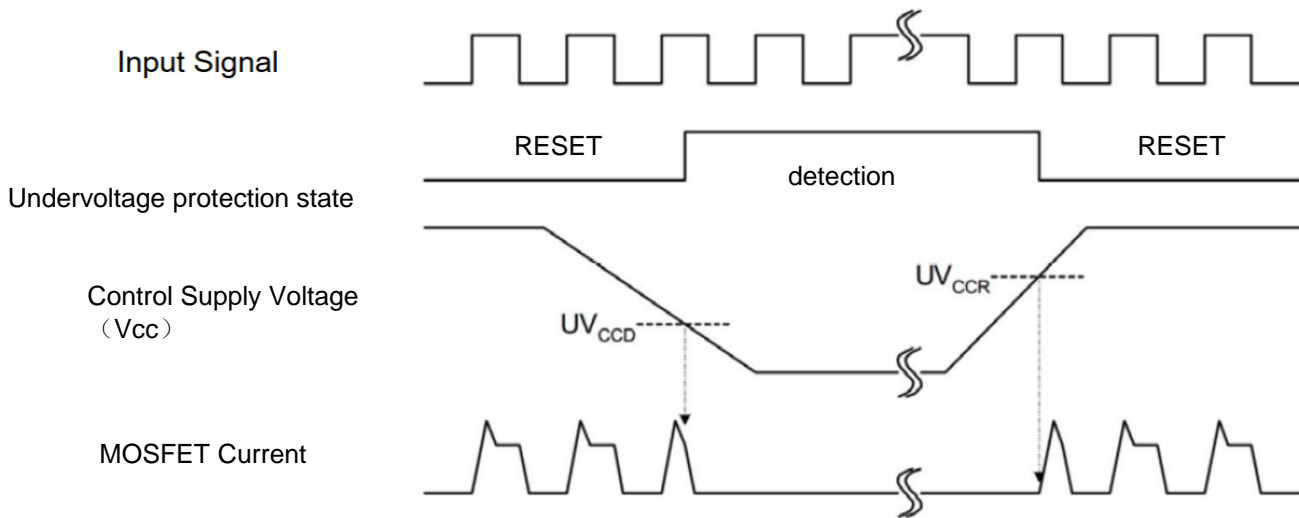


Fig 6: Undervoltage protection sequence diagram (low side)

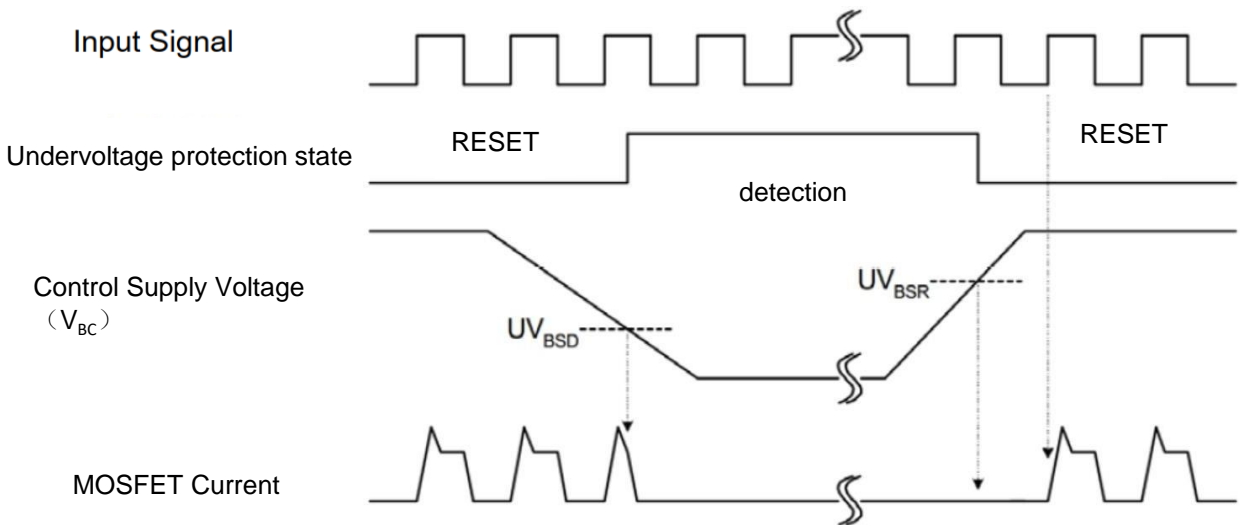
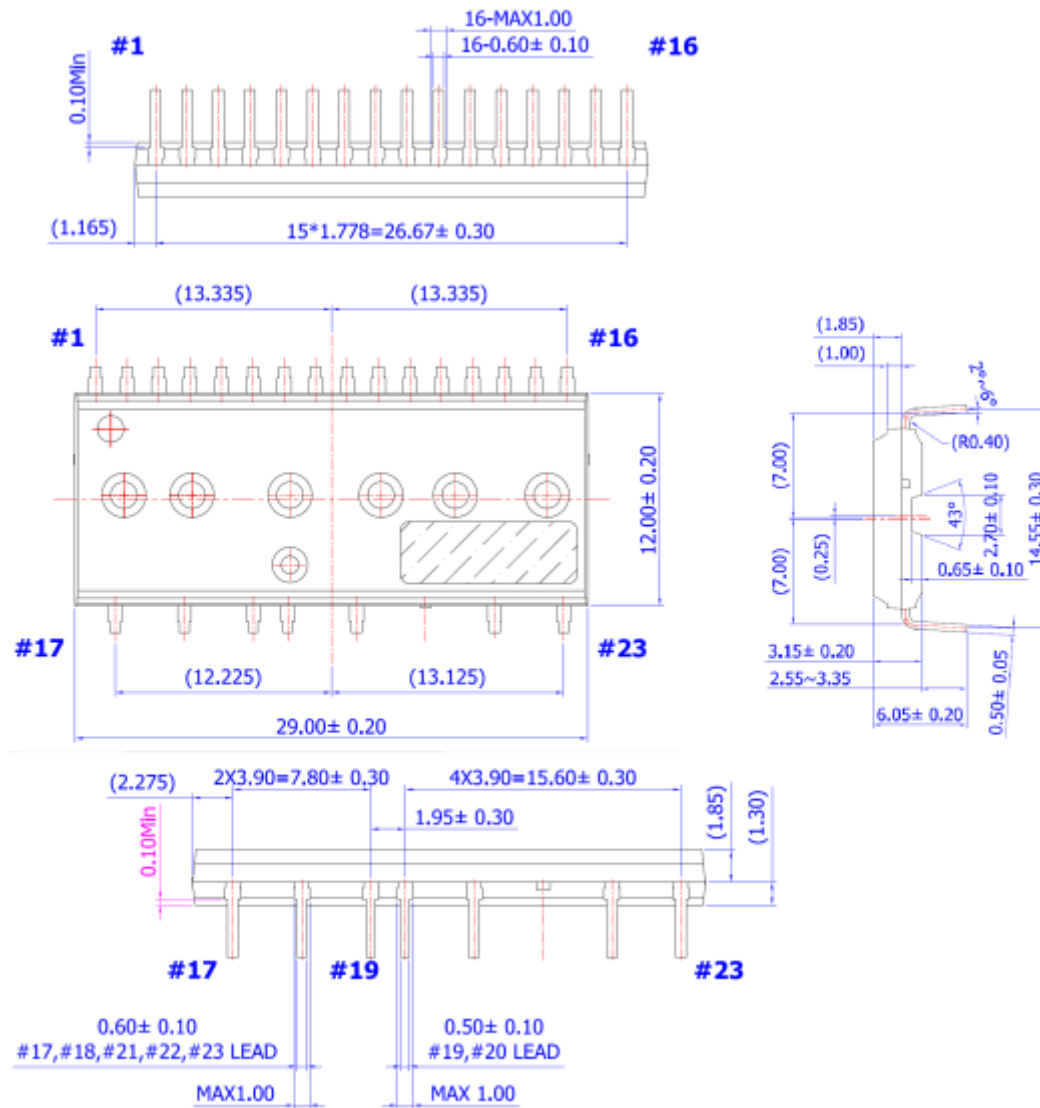


Fig 4: Undervoltage protection sequence diagram (High side)

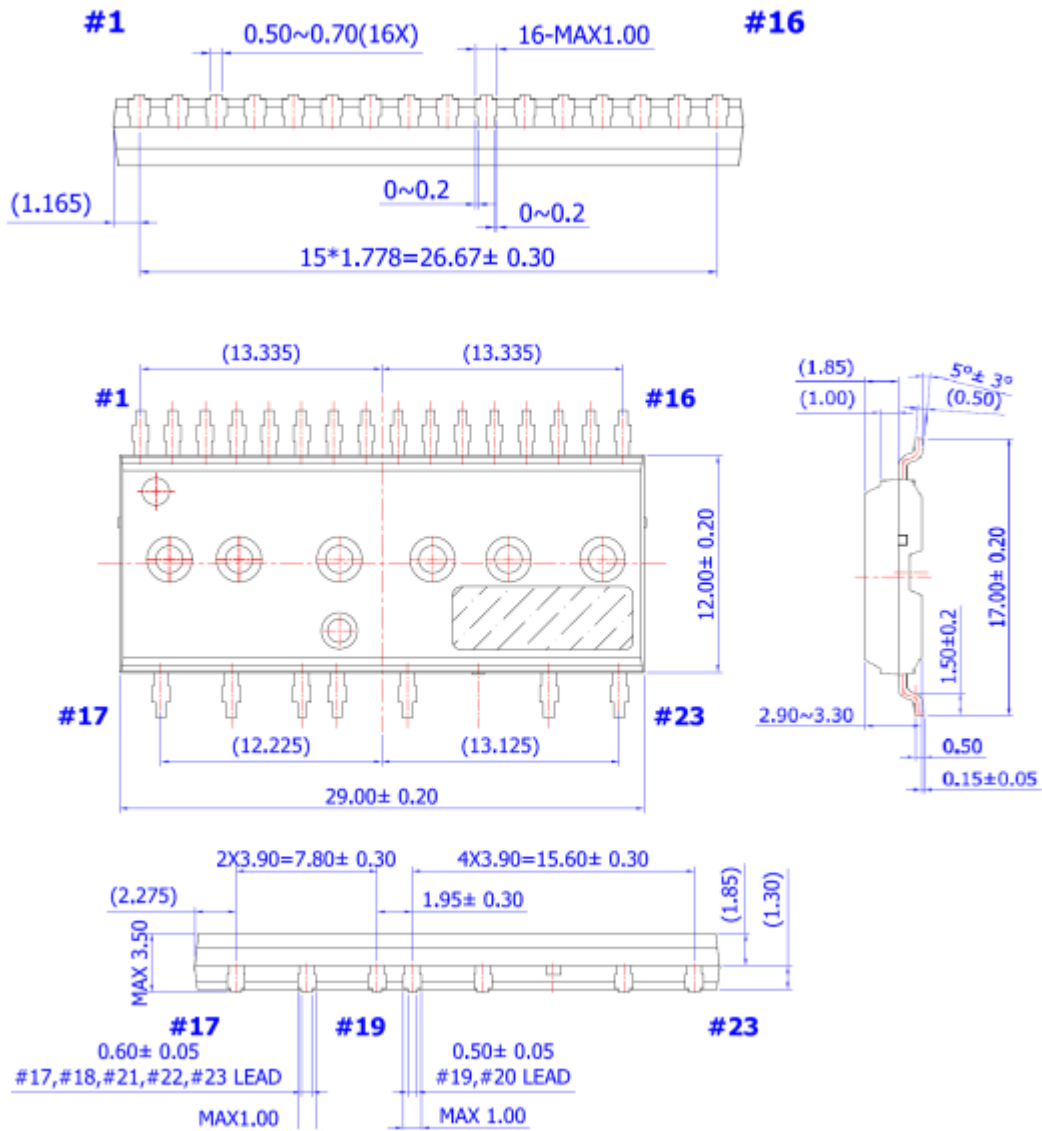
Detailed Package Outline Drawings

DIP23-FP



Detailed Package Outline Drawings

SOP23-EP



Attached 1 :

| R25=47KΩ±5% B25/50=4050±1% | | | | | | | |
|----------------------------|----------|----------|----------|-------|----------|----------|----------|
| T(°C) | Rmin(kΩ) | Rnor(kΩ) | Rmax(kΩ) | T(°C) | Rmin(kΩ) | Rnor(kΩ) | Rmax(kΩ) |
| -40 | 1438.40 | 1568.15 | 1705.34 | 9 | 92.731 | 98.335 | 104.017 |
| -39 | 1346.94 | 1467.47 | 1594.79 | 10 | 88.440 | 93.740 | 99.109 |
| -38 | 1261.90 | 1373.92 | 1492.14 | 11 | 84.368 | 89.381 | 94.456 |
| -37 | 1182.81 | 1286.96 | 1396.78 | 12 | 80.503 | 85.246 | 90.042 |
| -36 | 1109.19 | 1206.08 | 1308.15 | 13 | 76.832 | 81.320 | 85.856 |
| -35 | 1040.65 | 1130.82 | 1225.73 | 14 | 73.345 | 77.594 | 81.883 |
| -34 | 976.79 | 1060.75 | 1149.05 | 15 | 70.033 | 74.055 | 78.112 |
| -33 | 917.27 | 995.48 | 1077.66 | 16 | 66.885 | 70.694 | 74.532 |
| -32 | 861.77 | 934.66 | 1011.18 | 17 | 63.893 | 67.500 | 71.132 |
| -31 | 809.98 | 877.94 | 949.22 | 18 | 61.049 | 64.465 | 67.903 |
| -30 | 761.64 | 825.03 | 891.47 | 19 | 58.343 | 61.580 | 64.834 |
| -29 | 716.50 | 775.65 | 837.59 | 20 | 55.770 | 58.837 | 61.918 |
| -28 | 674.32 | 729.55 | 787.32 | 21 | 53.322 | 56.229 | 59.146 |
| -27 | 634.90 | 686.47 | 740.39 | 22 | 50.991 | 53.747 | 56.510 |
| -26 | 598.02 | 646.22 | 696.55 | 23 | 48.773 | 51.386 | 54.004 |
| -25 | 563.53 | 608.58 | 655.58 | 24 | 46.661 | 49.139 | 51.619 |
| -24 | 531.24 | 573.36 | 617.28 | 25 | 44.650 | 47.000 | 49.350 |
| -23 | 501.00 | 540.41 | 581.46 | 26 | 42.696 | 44.963 | 47.232 |
| -22 | 472.67 | 509.55 | 547.94 | 27 | 40.836 | 43.024 | 45.215 |
| -21 | 446.12 | 480.65 | 516.55 | 28 | 39.065 | 41.176 | 43.292 |
| -20 | 421.23 | 453.57 | 487.16 | 29 | 37.379 | 39.415 | 41.459 |
| -19 | 397.77 | 428.06 | 459.50 | 30 | 35.772 | 37.737 | 39.711 |
| -18 | 375.77 | 404.15 | 433.58 | 31 | 34.241 | 36.138 | 38.045 |
| -17 | 355.12 | 381.72 | 409.29 | 32 | 32.782 | 34.613 | 36.455 |
| -16 | 335.74 | 360.68 | 386.51 | 33 | 31.391 | 33.159 | 34.939 |
| -15 | 317.53 | 340.93 | 365.14 | 34 | 30.066 | 31.772 | 33.492 |
| -14 | 300.43 | 322.39 | 345.09 | 35 | 28.801 | 30.449 | 32.110 |
| -13 | 284.35 | 304.96 | 326.26 | 36 | 27.595 | 29.186 | 30.792 |
| -12 | 269.23 | 288.59 | 308.57 | 37 | 26.444 | 27.981 | 29.533 |
| -11 | 255.01 | 273.20 | 291.95 | 38 | 25.346 | 26.830 | 28.330 |
| -10 | 241.62 | 258.72 | 276.33 | 39 | 24.298 | 25.732 | 27.181 |
| -9 | 229.03 | 245.09 | 261.63 | 40 | 23.298 | 24.682 | 26.084 |
| -8 | 217.16 | 232.27 | 247.81 | 41 | 22.342 | 23.680 | 25.035 |
| -7 | 205.98 | 220.19 | 234.80 | 42 | 21.430 | 22.723 | 24.033 |
| -6 | 195.44 | 208.82 | 222.55 | 43 | 20.559 | 21.807 | 23.074 |
| -5 | 185.51 | 198.10 | 211.02 | 44 | 19.726 | 20.933 | 22.158 |
| -4 | 176.13 | 187.99 | 200.15 | 45 | 18.930 | 20.097 | 21.282 |
| -3 | 167.29 | 178.46 | 189.90 | 46 | 18.170 | 19.297 | 20.443 |
| -2 | 158.95 | 169.47 | 180.24 | 47 | 17.443 | 18.533 | 19.641 |
| -1 | 151.07 | 160.99 | 171.13 | 48 | 16.748 | 17.802 | 18.874 |
| 0 | 143.62 | 152.98 | 162.53 | 49 | 16.083 | 17.102 | 18.139 |
| 1 | 136.67 | 145.50 | 154.51 | 50 | 15.448 | 16.432 | 17.436 |
| 2 | 130.08 | 138.42 | 146.92 | 51 | 14.847 | 15.800 | 16.772 |
| 3 | 123.85 | 131.72 | 139.74 | 52 | 14.273 | 15.195 | 16.136 |
| 4 | 117.95 | 125.38 | 132.94 | 53 | 13.724 | 14.616 | 15.527 |
| 5 | 112.35 | 119.37 | 126.51 | 54 | 13.198 | 14.061 | 14.944 |
| 6 | 107.05 | 113.68 | 120.42 | 55 | 12.695 | 13.531 | 14.385 |
| 7 | 102.02 | 108.29 | 114.66 | 56 | 12.214 | 13.022 | 13.850 |
| 8 | 97.25 | 103.18 | 109.19 | 57 | 11.753 | 12.536 | 13.338 |

| R25=47KΩ±5% B25/50=4050±1% | | | | | | | |
|----------------------------|----------|----------|----------|-------|----------|----------|----------|
| T(°C) | Rmin(kΩ) | Rnor(kΩ) | Rmax(kΩ) | T(°C) | Rmin(kΩ) | Rnor(kΩ) | Rmax(kΩ) |
| 58 | 11.3111 | 12.0694 | 12.8463 | 105 | 2.2748 | 2.4661 | 2.6669 |
| 59 | 10.8882 | 11.6225 | 12.3753 | 106 | 2.2067 | 2.3930 | 2.5886 |
| 60 | 10.4830 | 11.1942 | 11.9238 | 107 | 2.1409 | 2.3224 | 2.5130 |
| 61 | 10.0948 | 10.7837 | 11.4908 | 108 | 2.0774 | 2.2542 | 2.4399 |
| 62 | 9.7227 | 10.3901 | 11.0755 | 109 | 2.0160 | 2.1882 | 2.3692 |
| 63 | 9.3661 | 10.0126 | 10.6771 | 110 | 1.9567 | 2.1245 | 2.3009 |
| 64 | 9.0241 | 9.6506 | 10.2948 | 111 | 1.8994 | 2.0629 | 2.2348 |
| 65 | 8.6961 | 9.3033 | 9.9279 | 112 | 1.8440 | 2.0033 | 2.1709 |
| 66 | 8.3815 | 8.9700 | 9.5758 | 113 | 1.7904 | 1.9456 | 2.1090 |
| 67 | 8.0797 | 8.6501 | 9.2377 | 114 | 1.7386 | 1.8899 | 2.0492 |
| 68 | 7.7901 | 8.3431 | 8.9130 | 115 | 1.6886 | 1.8360 | 1.9913 |
| 69 | 7.5122 | 8.0483 | 8.6012 | 116 | 1.6401 | 1.7839 | 1.9353 |
| 70 | 7.2454 | 7.7652 | 8.3016 | 117 | 1.5933 | 1.7334 | 1.8811 |
| 71 | 6.9892 | 7.4934 | 8.0139 | 118 | 1.5479 | 1.6846 | 1.8287 |
| 72 | 6.7432 | 7.2322 | 7.7373 | 119 | 1.5041 | 1.6373 | 1.7779 |
| 73 | 6.5070 | 6.9813 | 7.4715 | 120 | 1.4616 | 1.5915 | 1.7287 |
| 74 | 6.2800 | 6.7402 | 7.2160 | 121 | 1.4206 | 1.5473 | 1.6810 |
| 75 | 6.0619 | 6.5084 | 6.9703 | 122 | 1.3808 | 1.5044 | 1.6349 |
| 76 | 5.8524 | 6.2856 | 6.7340 | 123 | 1.3423 | 1.4629 | 1.5902 |
| 77 | 5.6510 | 6.0714 | 6.5068 | 124 | 1.3051 | 1.4226 | 1.5469 |
| 78 | 5.4574 | 5.8654 | 6.2882 | 125 | 1.2690 | 1.3837 | 1.5050 |
| 79 | 5.2712 | 5.6673 | 6.0779 | 126 | 1.2340 | 1.3460 | 1.4644 |
| 80 | 5.0922 | 5.4767 | 5.8755 | 127 | 1.2002 | 1.3094 | 1.4250 |
| 81 | 4.9217 | 5.2950 | 5.6825 | 128 | 1.1674 | 1.2740 | 1.3868 |
| 82 | 4.7576 | 5.1203 | 5.4968 | 129 | 1.1356 | 1.2397 | 1.3498 |
| 83 | 4.5998 | 4.9521 | 5.3180 | 130 | 1.1049 | 1.2064 | 1.3140 |
| 84 | 4.4479 | 4.7901 | 5.1458 | 131 | 1.0750 | 1.1741 | 1.2792 |
| 85 | 4.3017 | 4.6342 | 4.9800 | 132 | 1.0461 | 1.1429 | 1.2455 |
| 86 | 4.1609 | 4.4841 | 4.8202 | 133 | 1.0181 | 1.1126 | 1.2128 |
| 87 | 4.0254 | 4.3395 | 4.6663 | 134 | 0.9910 | 1.0832 | 1.1810 |
| 88 | 3.8949 | 4.2001 | 4.5180 | 135 | 0.9646 | 1.0547 | 1.1503 |
| 89 | 3.7692 | 4.0659 | 4.3750 | 136 | 0.9391 | 1.0270 | 1.1204 |
| 90 | 3.6482 | 3.9366 | 4.2372 | 137 | 0.9143 | 1.0002 | 1.0915 |
| 91 | 3.5315 | 3.8119 | 4.1044 | 138 | 0.8903 | 0.9742 | 1.0633 |
| 92 | 3.4191 | 3.6918 | 3.9763 | 139 | 0.8670 | 0.9490 | 1.0361 |
| 93 | 3.3107 | 3.5759 | 3.8527 | 140 | 0.8444 | 0.9245 | 1.0096 |
| 94 | 3.2063 | 3.4642 | 3.7335 | 141 | 0.8225 | 0.9007 | 0.9839 |
| 95 | 3.1056 | 3.3565 | 3.6186 | 142 | 0.8012 | 0.8776 | 0.9589 |
| 96 | 3.0085 | 3.2526 | 3.5076 | 143 | 0.7806 | 0.8552 | 0.9347 |
| 97 | 2.9149 | 3.1523 | 3.4006 | 144 | 0.7605 | 0.8335 | 0.9112 |
| 98 | 2.8245 | 3.0556 | 3.2973 | 145 | 0.7411 | 0.8124 | 0.8883 |
| 99 | 2.7374 | 2.9622 | 3.1975 | 146 | 0.7222 | 0.7919 | 0.8661 |
| 100 | 2.6533 | 2.8721 | 3.1012 | 147 | 0.7039 | 0.7720 | 0.8446 |
| 101 | 2.5722 | 2.7851 | 3.0082 | 148 | 0.6861 | 0.7527 | 0.8236 |
| 102 | 2.4938 | 2.7012 | 2.9184 | 149 | 0.6688 | 0.7339 | 0.8033 |
| 103 | 2.4182 | 2.6201 | 2.8316 | 150 | 0.6520 | 0.7156 | 0.7835 |
| 104 | 2.3452 | 2.5418 | 2.7478 | | | | |