# Gate Driver Module   2CG010BBC11N

## ■Overview

Gate driver 2CG010BBC11N is a dual channel gate driver designed for IGBT and SiC MOSFET.

The high breakdown voltage and low parasitic capacitance make it suitable for gate drives such as SiC MOSFET and IGBT.

## ■Features

- ・Ideal for drive of IGBT and SiC MOSFET
- ・Gate voltage : +15V/-10V
- ・ALL-IN-ONE (Built-in isolated DC / DC converter and gate drive circuit)
- ・Low parasitic capacitance (about 12pF) ; highly resistant to common-mode noise.
- ・Fast response : about 100nsec(typ)
- ・The isolation for primary-secondary signal used fast response isolator.
- ・Input-to-Output dielectric withstand voltage : AC5000V
- ・Output CH1-to-Ouput CH2 dielectric withstand voltage : AC4000V
- ・Input-to-Output insulation distance : 14mm (clearance), 16mm(creepage)   (As for Gate driver module PCB)
- ・Output CH1-to-Output CH2 insulation distance : 7mm (clearance), 12mm(creepage)
- ・DC/DC converter input voltage :13～28V
- ・Signal input voltage : 3.3V,5V
- ・Overload protection (DC/DC converter)
- ・Overheat protection (DC/DC converter)
- ・Half bridge mode (Gate drive circuit)
- ・Desaturation protection (Gate drive circuit)
- ・Soft turn-off function (Gate drive circuit)
- ・Fault signal output function (Gate drive circuit)
- ・Miller function (Gate drive circuit)
- ・Under-voltage lockout(UVLO) (Gate drive circuit)
- ・Insulating moistureproof coating
- ・Safety standards : UL508(file no.E243511) (DC/DC converter only)
- ・Reinforced isolation according to IEC 60664-1 (IEC61800-5-1, IEC62477-1, IEC62109-1, etc.)
- ・UL compliant (UL1741, UL508, etc.)

## ■Application

Industrial inverter, power conditioner, etc ⋯

## ■Module information

| Part number | Output voltage | Miller clamp | Status |
|---|---|---|---|
| 2CG010BBC11N | +15V/-10V | Yes | Active |
| 2CG010BBC12N | +15V/-15V | Yes | Active |
| 2CG010BBC13N | +18V/-4V | Yes | Active |
| 2CG010BBC14N | +18V/-2V | Yes | Active |

■**Circuit Image**
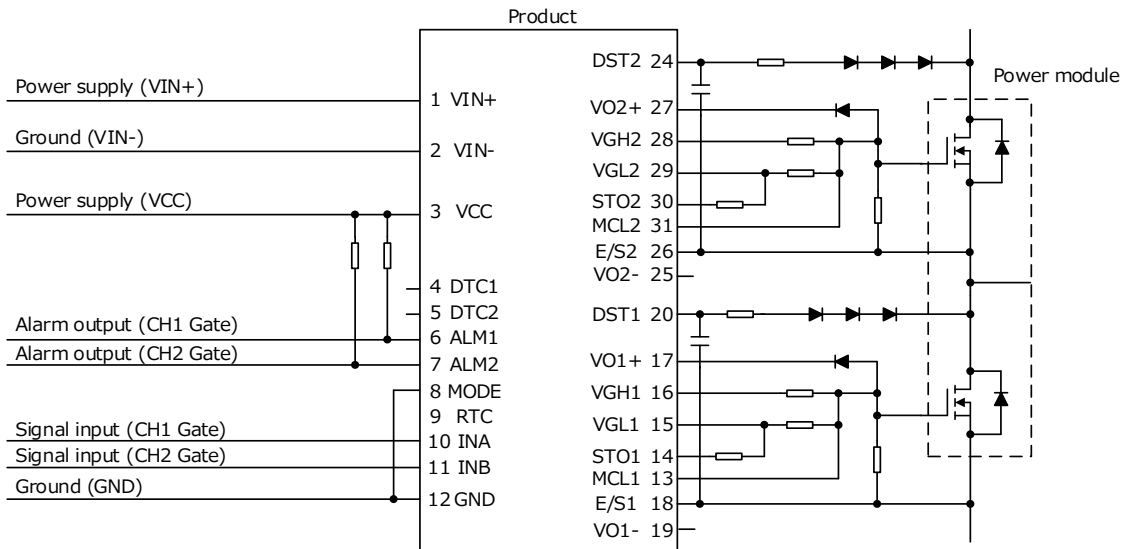


■**Pin Connection**

Input

| Pin No. | Name | CH | Function |
|---|---|---|---|
| 1 | VIN+ | Common | Power supply for DC/DC converter(+) |
| 2 | VIN- | Common | Power supply for DC/DC converter(−) |
| 3 | VCC | - | Power supply for drive circuit |
| 4 | DTC1 | 1 | Dead time adjustment |
| 5 | DTC2 | 2 | Dead time adjustment |
| 6 | ALM1 | 1 | Alarm signal output |
| 7 | ALM2 | 2 | Alarm signal output |
| 8 | MOD | - | Mode select |
| 9 | RTC | - | Recovery time of protection circuit control |
| 10 | INA | 1 | Control input A |
| 11 | INB | 2 | Control input B |
| 12 | GND | - | Ground for drive circuit |

Output

| Pin No. | Name | CH | Function |
|---|---|---|---|
| 13 | MCL1 | 1 | Miller clamp pin |
| 14 | STO1 | 1 | Soft turn off pin |
| 15 | VGL1 | 1 | Gate OFF side pin |
| 16 | VGH1 | 1 | Gate ON side pin |
| 17 | VO1+ | 1 | DC/DC converter output pin |
| 18 | E/S1 | 1 | Emitter・source connection pin |
| 19 | VO1- | 1 | DC/DC converter output pin |
| 20 | DST1 | 1 | Desaturation protection pin |
| 21 | NONE | - | None |
| 22 | NONE | - | None |
| 23 | NONE | - | None |
| 24 | DST2 | 2 | Desaturation protection pin |
| 25 | VO2- | 2 | DC/DC converter output pin |
| 26 | E/S2 | 2 | Emitter・source connection pin |
| 27 | VO2+ | 2 | DC/DC converter output pin |
| 28 | VGH2 | 2 | Gate ON side pin |
| 29 | VGL2 | 2 | Gate OFF side pin |
| 30 | STO2 | 2 | Soft turn off pin |
| 31 | MCL2 | 2 | Miller clamp pin |

■ **Internal Block Diagram**
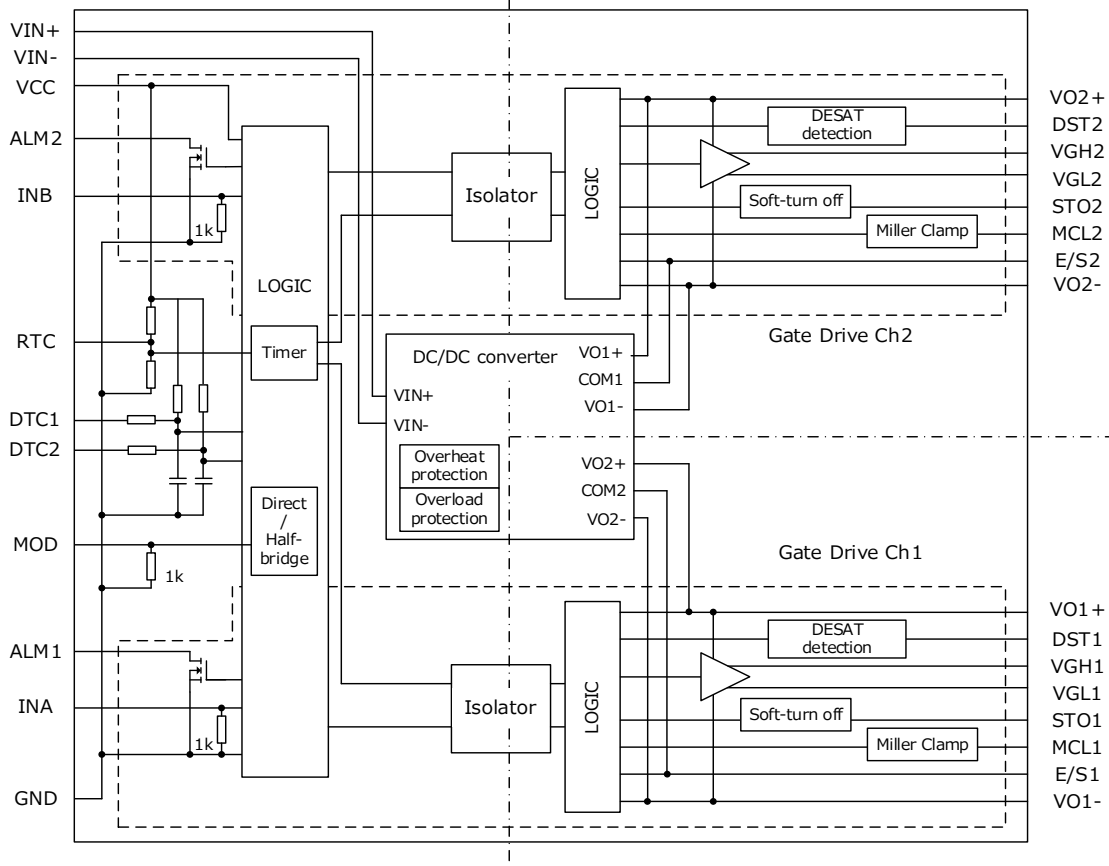


■ **I/O Condition Table**

| No. | Status | Input | | | | | | | | Output(CH2) | | | | | Output(CH1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VO+ | DST2 | DST1 | MCL2 | MCL1 | MOD | INB | INA | ALM2 | VGH2 | VGL2 | STO2 | MCL2 | ALM1 | VGH1 | VGL1 | STO1 | MCL1 |
| 1 | VOx+ UVLO | UVLO | X | X | X | X | X | X | X | L | Hi-Z | Hi-Z | L | L | L | Hi-Z | Hi-Z | L | L |
| 2 | ES-VOx- short | X | X | X | X | X | X | X | X | L | Hi-Z | SD | SD | SD | L | Hi-Z | SD | SD | SD |
| 3 | Normal operation (Direct Mode) | ○ | - | L | - | H | L | - | L | - | - | - | - | - | Hi-Z | Hi-Z | L | L | Hi-Z |
| 4 | | ○ | - | L | - | L | L | - | L | - | - | - | - | - | Hi-Z | Hi-Z | L | L | L |
| 5 | | ○ | - | L | - | H | L | - | H | - | - | - | - | - | Hi-Z | H | Hi-Z | Hi-Z | Hi-Z |
| 6 | | ○ | L | - | H | - | L | L | - | Hi-Z | Hi-Z | L | L | Hi-Z | - | - | - | - | - |
| 7 | | ○ | L | - | L | - | L | L | - | Hi-Z | Hi-Z | L | L | L | - | - | - | - | - |
| 8 | | ○ | L | - | H | - | L | H | - | Hi-Z | H | Hi-Z | Hi-Z | Hi-Z | - | - | - | - | - |
| 9 | Normal operation (Half-bridge Mode) | ○ | L | L | L | L | H | L | X | Hi-Z | Hi-Z | L | L | L | Hi-Z | Hi-Z | L | L | L |
| 10 | | ○ | L | L | H | L | H | H | L | Hi-Z | H | Hi-Z | Hi-Z | Hi-Z | Hi-Z | Hi-Z | L | L | L |
| 11 | | ○ | L | L | L | H | H | H | H | Hi-Z | Hi-Z | L | L | L | Hi-Z | H | Hi-Z | Hi-Z | Hi-Z |
| 12 | Desaturation protection1 | ○ | - | Hi-Z | - | L | L | - | L | - | - | - | - | - | Hi-Z | Hi-Z | L | L | L |
| 13 | | ○ | - | Hi-Z | - | H | L | - | H | - | - | - | - | - | L | Hi-Z | Hi-Z | L | Hi-Z |
| 14 | | ○ | - | Hi-Z | - | L | H | H | L | - | - | - | - | - | Hi-Z | Hi-Z | L | L | L |
| 15 | | ○ | - | Hi-Z | - | H | H | H | H | - | - | - | - | - | L | Hi-Z | Hi-Z | L | Hi-Z |
| 16 | Desaturation protection2 | ○ | Hi-Z | - | L | - | L | L | - | Hi-Z | Hi-Z | L | L | L | - | - | - | - | - |
| 17 | | ○ | Hi-Z | - | H | - | L | H | - | L | Hi-Z | Hi-Z | L | Hi-Z | - | - | - | - | - |
| 18 | | ○ | Hi-Z | - | L | - | H | H | H | Hi-Z | Hi-Z | L | L | L | - | - | - | - | - |
| 19 | | ○ | Hi-Z | - | H | - | H | H | L | L | Hi-Z | Hi-Z | L | Hi-Z | - | - | - | - | - |

○ : Vox+ UVLO > UVLO, X : Don't care, SD : Shut down

■ **Absolute Maximum Ratings**

| Item | | Symbol | Min | Max | Unit | Conditions・Note |
|---|---|---|---|---|---|---|
| Input voltage for DC/DC converter | | $V_{IN}$ | -0.3 | 28 | Vdc | Between VIN+ to VIN- |
| Input-side signal voltage | | $V_{CC}, V_{SG}$ | -0.3 | 5.5 | V | VCC, RTC, MOD, INA, INB |
| | | $V_{ALM}$ | -0.3 | 28 | V | ALM1, ALM2 |
| Input-side signal maximum current | | $I_{ALM}$ | - | 5 | mA | ALM1, ALM2 |
| DESAT pin input voltage | | $V_{DESAT}$ | -0.3 | $V_{GH}$+0.3 | V | |
| Miller clamp pin input voltage | | $V_{CLAMP}$ | $V_{GL}$-0.3 | $V_{GH}$+0.3 | V | |
| Maximum gate current | | $I_{GPEAK}$ | - | 43 | A | |
| DC/DC converter output power | | $P_{OUT}$ | - | 4 | W | Per output circuit |
| Switching frequency | | $F_{SW}$ | - | 150 | kHz | See the permissible frequency curve |
| Operating temperature range | $V_{IN}$=13.5-18V | $T_{OP}$ | -40 | 85 | ℃ | See the permissible frequency curve |
| | $V_{IN}$=18-26.4V | $T_{OP}$ | -40 | 75 | ℃ | |
| Operating humidity | | $RH_{OP}$ | 20 | 95 | %RH | No condensation |
| Storage temperature range | | $T_{STG}$ | -40 | 90 | ℃ | |
| Storage humidity | | $RH_{STG}$ | 5 | 95 | %RH | No condensation |

■ **Recommended Operating Conditions**

| Item | Symbol | Min | Max | Unit | Conditions・Note |
|---|---|---|---|---|---|
| Input voltage range for DC/DC converter | $V_{IN}$ | 13.5 | 26.4 | Vdc | |
| Input-side signal voltage range | $V_{CC}, V_{SG}$ | 3 | 5.5 | Vdc | |
| Driver circuit number | N | - | 2 | - | |
| Logic high level input voltage | $V_{SGH}$ | $V_{CC}$ x0.7 | - | V | MOD, INA, INB |
| Logic low level input voltage | $V_{SGL}$ | - | $V_{CC}$ x0.3 | V | MOD, INA, INB |
| Source current of control signal | $I_{SG}$ | 5 | - | mA | MOD, INA, INB $V_{SG}$=5V |
| Maximum gate drive capability （150 kHz) | $Q_{MAX}$ | - | 160 | nC | Gate current (ave) = 24mA  Reference value |
| Maximum gate drive capability （30 kHz) | $Q_{MAX}$ | - | 4900 | nC | Gate current (ave) = 147mA  Reference value |
| Maximum gate charge amount | $Q_G$ | - | 7000 | nC | |
| Minimum input pulse width | $t_{INMSK}$ | 60 | - | ns | |

■ **Permissible frequency curve**

Total gate charge (Qg) vs permissible frequency curve



—— Ta:−40～+85℃ / VIN = 13.5～18V
Ta:−40～+75℃ / VIN = 18～26.4V

----- Ta:−40～+60℃ / VIN = 13.5～26.4V
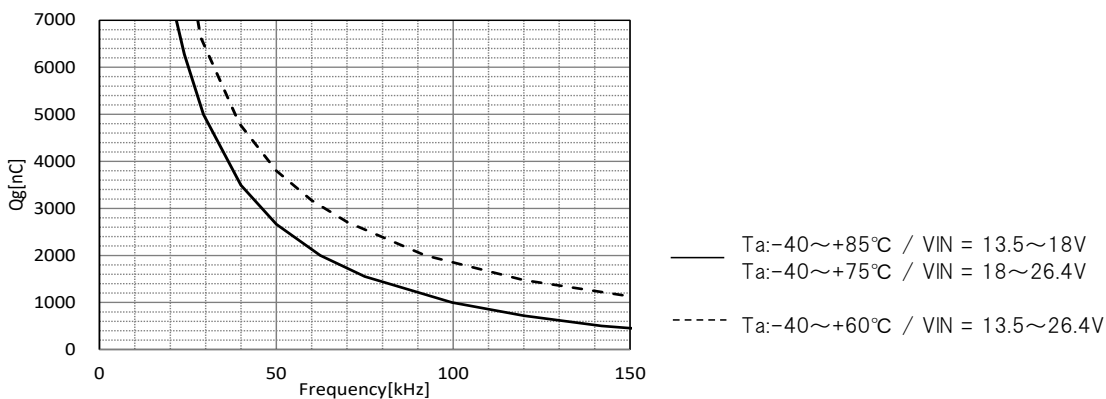
■**Electrical Specification   (Vin=24V, Vcc=5V.Ta=25℃, Unless otherwise specified)**

| Item | | Symbol | Min | Typ | Max | Unit | Conditions・Note |
|---|---|---|---|---|---|---|---|
| DC/DC converter | | | | | | | |
| Start-up voltage | | $V_{START}$ | - | - | 13 | V | |
| Input current | | $I_{IN}$ | - | 0.42 | - | A | Fsw=22kHz / Test load: 280nF |
| Standby power | | $P_{STBY}$ | - | 1.2 | - | W | No load |
| Logic inputs | | | | | | | |
| Logic high level input voltage | | $V_{SGH}$ | $V_{CC}$ x0.7 | - | - | V | MOD, INA, INB / Guaranteed by design |
| Logic low level input voltage | | $V_{SGL}$ | - | - | $V_{CC}$ x0.3 | V | MOD, INA, INB / Guaranteed by design |
| Logic pull-down resistance | | $R_{SGD}$ | - | 1000 | - | Ω | MOD, INA, INB |
| Gate driver output | | | | | | | |
| Gate ON side pin / output voltage(+) | | $V_{GH},V_{O+}$ | 14 | 15 | 16 | V | No load |
| Gate OFF side pin / output voltage(-) | | $V_{GL},V_{O-}$ | -11 | -10 | -9 | V | No load |
| Miller clamp voltage | | $V_{CLAMP}$ | - | 1.2 | - | V | $I_{CLAMP}$=500mA, Guaranteed by design |
| Miller clamp ON threshold voltage | | $V_{CLPON}$ | - | $V_{GL}$+2 | - | V | |
| Delay time | Turn ON time | $t_{PON}$ | - | 100 | - | ns | |
| | Turn OFF time | $t_{POFF}$ | - | 100 | - | ns | |
| Dead time | | $t_{DEAD}$ | - | 4.1 | - | us | Half bridge mode |

■**Protection**

| Item | Symbol | Min | Typ | Max | Unit | Conditions・Note |
|---|---|---|---|---|---|---|
| DC/DC converter | | | | | | |
| Overload protection | - | 10.5 | - | - | W | Auto recovery |
| Overheat protection | - | 120 | - | 150 | ℃ | Auto recovery, Internal temperature |
| Gate driver | | | | | | |
| Output voltage(H) UVLO OFF voltage | $V_{UVLOGHH}$ | 13.2 | 13.5 | 13.8 | V | Guaranteed by design |
| Output voltage(H) UVLO ON voltage | $V_{UVLOGHL}$ | 12.2 | 12.5 | 12.8 | V | Guaranteed by design |
| DESAT charge current | $I_{DESAT}$ | 200 | 240 | 280 | uA | Guaranteed by design |
| DESAT detection voltage | $V_{DESAT}$ | 6.0 | 6.35 | 7.0 | V | Guaranteed by design |
| DESAT detection filter time | $t_{DSTFIL}$ | - | 400 | - | ns | DSTxpin open |
| DESAT detection time | $t_{DSTOUT}$ | - | 450 | - | ns | DSTxpin open |
| Alarm signal output L voltage | $V_{ALML}$ | - | - | 0.5 | V | $I_{ALM}$=5mA |
| Alarm signal output time | $t_{ALM}$ | - | 650 | - | ns | |
| Restart time | $t_{RESTART}$ | - | 110 | - | ms | |
| Soft turn off duration | $t_{STO}$ | - | 4 | - | us | |

■**Insulation**

| Item | Specification | Conditions・Note |
|---|---|---|
| Between Input-Output | | |
| Dielectric withstand voltage | AC5000V | 1min, Cutoff 2mA |
| Insulation resistance | 100MΩ or more | DC500V |
| Partial discharge extinction volt. | 1768Vpeak or more | According to EN50178/IEC 60270 |
| Common-mode transient immunity (CMTI) | 70kV/us | |
| Minimum clearance distances | 14mm | |
| Minimum creepage distances | 16mm | As for Gate driver module PCB |
| Between CH1-CH2 | | |
| Dielectric withstand voltage | AC4000V | 1min, Cutoff 2mA |
| Insulation resistance | 100MΩ or more | DC500V |
| Partial discharge extinction volt. | 1700Vpeak or more | According to EN50178/IEC 60270 |
| Minimum clearance distances | 7mm | |
| Minimum creepage distances | 12mm | As for Gate driver module PCB |

■**Storage Conditions**

| Item | Min | Max | Unit | Conditions・Note |
|---|---|---|---|---|
| Storage temperature | -25 | 60 | ℃ | A packing state |

※If you want to use past the long period there is a concern that the solder non-wetting by terminal oxidation to occur.
　Therefore, please use from taking enough tests.

■**Recommended Soldering Condition**

・Flow soldering condition　　　　　　　　　 : 255±3℃ Less than 3sec
　　　　　　　　　　　　　　　　　　　　　　 Temperature of preheating 110℃〜130℃
　　　　　　　　　　　　　　　　　　　　　　 End temperature of preheating 110℃±10℃
・Soldering condition of hand work　　　　　 : 360℃(MAX) Less than 3sec

■**Usage Cautions**

● Always mount fuse on the plus side of input for ensuring safety because the fuse is not built-in the product.
　Please select the fuse considering conditions such as steady current, inrush current, and ambient temperature.
　When using a fuse having large rated current or high capacity input electrolytic condenser, by combining
　another converter and input line and input electrolytic condenser, fuse may not blow off in the case of abnormality.
　Do not combine high voltage line and fuse.

● Make sure the rise/fall time of the input signal is 500ns or less.

● This product has DESAT protection for arm short circuit and load short circuit protection.
　However, even if this protection works, the IGBT may be damaged if abnormally high current occurs due to IGBT's characteristics
　variations or the load short-circuit mode during parallel operation.
　To ensure safety, be sure to check the short-circuit current at the unit in which this product is integrated,
　and evaluate whether it can protect under the condition that there is no damage to the IGBT.

● The coating material is applied to the product, so it may appear to be partially whitened.
　This does not affect the characteristics of the product.

■ **Outline Dimensional Drawing**
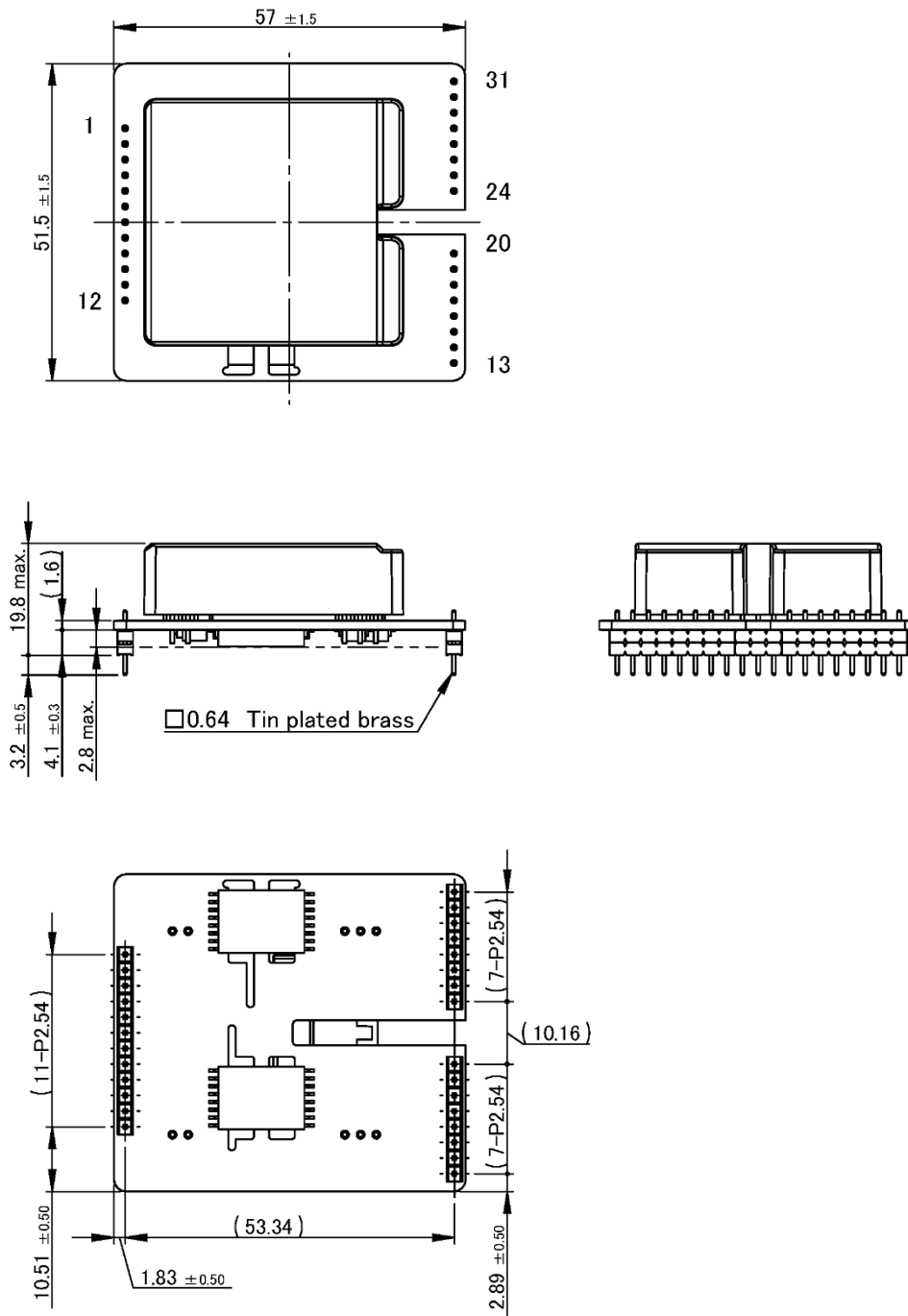
Unit: mm

Note: 1. The dimensional tolerance without directions is ± 0.5mm.

■ **Product Weight**

45.0g(typ)

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- This information and product are subject to change without prior notice for the purpose of improvements, etc.
  Ensure that you are in possession of the most up-to-date information when using this product.

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    - Use in liquids such as water, oil, chemical solutions, or organic solvents, and use in locations
      where the product will be exposed to such liquids.
    - Use that involves exposure to direct sunlight, outdoor exposure, or dusty conditions.
    - Use in locations where corrosive gases such as salt air, C12, H2S, NH3, SO2, or NO2, are present.
    - Use in environments with strong static electricity or electromagnetic radiation.
    - Use that involves placing inflammable material next to the product.
    - Use of this product either sealed with a resin filling or coated with resin.
    - Use of water or a water soluble detergent for flux cleaning.
    - Use in locations where condensation is liable to occur.

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