# Data Sheet

# 1SD536F2-1MBI1600U4C-120

## Single-Channel SCALE Plug-and Play IGBT Driver

Ultra-compact, high-performance driver for 2-level, 3-level and multilevel converters


## Abstract

**The SCALE plug-and-play driver 1SD536F2-1MBI1600U4C-120 is an ultra-compact single-channel intelligent gate driver designed for Fuji's high-power IGBTs of type 1MBI1600U4C-120. The driver features a fiber-optic interface, a built-in DC/DC power supply and a selectable operating mode via a jumper.**


For drivers adapted to other types of high-power and high-voltage IGBT modules, refer to www.IGBT-Driver.com/go/plug-and-play

## Product Highlights

- Plug-and-play solution
- Protects the IGBT from short-circuit failure
- Active clamping of $V_{ce}$ at turn-off
- Extremely reliable; long service life
- No electrolytic capacitors
- Gate current up to ±36A
- Electrical insulation 4000 $V_{AC}$
- Fiber-optic links
- Monitoring of supply voltage and fiber optics
- Switching frequency DC to max. 10kHz
- Duty cycle 0... 100%
- Built-in DC/DC power supply
- Shortens application development time

## Applications

- Three/multi-level converters
- Two-level converters
- Medium-voltage converters
- Industrial drives
- Traction
- Railroad power supplies
- Wind-power converters
- Radiology and laser technology
- Research
- Almost all other conceivable applications

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## Important Notes

This data sheet contains only product-specific data. For a detailed description, must-read application notes and common data that apply to the whole series, please refer to the “Description & Application Manual for 1SD536F2 SCALE High-Power IGBT Drivers”.

When applying SCALE plug-and-play drivers, please note that these drivers are specifically adapted to a particular type of IGBT module. Therefore, the type designation of SCALE plug-and-play drivers also includes the type designation of the corresponding IGBT module. **These drivers are not valid for IGBT modules other than those specified. Incorrect use may result in failure.**

## Mechanical and Electrical Interfaces

Dimensions: 193 x 50mm. Mounting Principle: Direct screw mount on IGBT.

| Interface | Remarks | Part type # |
|---|---|---|
| Drive signal input (Standard) | Fiber-optic receiver (Notes 16,18) | HFBR-2522 |
| Drive signal input (Opt. 01) | Fiber-optic receiver (Notes 16,20) | HFBR-2412Z |
| Status output (Standard) | Fiber-optic transmitter (Notes 16,19) | HFBR-1522 |
| Status output (Opt. 01) | Fiber-optic transmitter (Notes 16,21) | HFBR-1412Z |
| Power supply connector | On-board connector (Note 17) | 77315-101-05 |

| Power supply connector | Designator | Pin numbers |
|---|---|---|
| Ground | GND | 1, 2, 4, 5 |
| Supply voltage | $V_{DC}$ | 3 |

## Absolute Maximum Ratings

| Parameter | Remarks | Min | Max | Units |
|---|---|---|---|---|
| Supply voltage $V_{DC}$ | VDC to GND (Note 1) | 0 | 16 | V |
| Gate peak current $I_{out}$ | Note 8 | -36 | +36 | A |
| Average supply current $I_{DC}$ | Note 3 | | 500 | mA |
| Output power DC/DC converter | Notes 3,12 | | 5 | W |
| Switching frequency | Note 12 | | 10 | kHz |
| Test voltage (50Hz/1min) | Primary to output (Note 15) | | 4000 | $V_{AC(eff)}$ |
| DC-link voltage | Note 5 | | 800 | V |
| Operating temperature | Note 12 | -40 | +85 | °C |
| Storage temperature | | -40 | +90 | °C |

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## Electrical Characteristics

All data refer to +25°C and $V_{DC}$ = 15V unless otherwise specified

| **Power supply** | **Remarks** | **Min** | **Typ.** | **Max** | **Units** |
|---|---|---|---|---|---|
| Nominal supply voltage $V_{DC}$ | VDC to GND (Note 1) | 14.5 | 15 | 15.5 | V |
| Supply current $I_{DC}$ | Without load (Note 2) | | | | |
| | Standard | | 120 | | mA |
| | Opt. 01 | | 125 | | mA |
| Efficiency η | Internal DC/DC converter | | 85 | | % |
| Turn-on threshold $V_{th}$ | Note 4 | | 13 | | V |
| Hysteresis on/off | Note 4 | | 0.6 | | V |
| Coupling capacitance $C_{io}$ | Primary to output | | 15 | | pF |

| **Short-circuit protection** | **Remarks** | **Min** | **Typ.** | **Max** | **Units** |
|---|---|---|---|---|---|
| $V_{ce}$ monitoring threshold | Between aux. terminals | 50 | | 60 | V |
| Response time | 3-level mode (Note 11) | | 8.5 | 9 | µs |
| Response time | 2-level mode (Note 6) | | 9.5 | 10 | µs |
| Blocking time | 2-level mode (Note 7) | | 1 | | s |

| **Timing characteristics** | **Remarks** | **Min** | **Typ.** | **Max** | **Units** |
|---|---|---|---|---|---|
| Turn-on delay $t_{pd(on)}$ | Note 13 | | 350 | | ns |
| Turn-off delay $t_{pd(off)}$ | Note 13 | | 450 | | ns |
| Output rise time $t_{r(out)}$ | Note 9 | | 15 | | ns |
| Output fall time $t_{f(out)}$ | Note 9 | | 20 | | ns |
| Acknowledge delay time | At status output (Note 14) | | 380 | | ns |
| Acknowledge pulse width | At status output | 0.6 | | 1.8 | µs |

| **Gate output** | **Remarks** | **Min** | **Typ.** | **Max** | **Units** |
|---|---|---|---|---|---|
| Turn-on gate resistor $R_{g(on)}$ | Note 8 | | 3.3 | | Ω |
| Turn-off gate resistor $R_{g(off)}$ | Note 8 | | 7.3 | | Ω |

| **Electrical insulation** | **Remarks** | **Min** | **Typ.** | **Max** | **Units** |
|---|---|---|---|---|---|
| Operating voltage (Note 10) | Continuous or repeated | | | 1700 | V |
| Test voltage (50Hz/1min) | Primary to output (Note 15) | | | 4000 | $V_{AC(eff)}$ |
| Partial discharge extinction volt. | IEC1287 / <10pC | 1400 | | | $V_{AC(eff)}$ |
| Creepage distance | Primary to output | 21 | | | mm |

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| di/dt feedback | | Remarks |
|---|---|---|
| di/dt feedback implemented | Note 22 | no |

Footnotes to the key data

1) Supply voltages higher than those specified can lead to the destruction of the driver and protection circuits on the output side. The gate-emitter voltage tracks the primary supply voltage. (Not regulated by the supply circuitry or the gate drive unit.)
2) Static power consumption of the gate driver.
3) If the specified power consumption is exceeded on average, this indicates an overload of the DC/DC converter. The DC/DC converter is not protected against overload.
4) Under-voltage monitoring of power supply. For a voltage lower than this limit, the power modules are switched off. The voltage refers to the secondary supply voltage of the gate driver, which is approximately the same as the voltage between VDC and GND.
5) This limit is due to active clamping. Refer to the “Description and Application Manual for 1SD536F2 SCALE High-Power IGBT Drivers”.
6) Pulse width of the direct output of the gate drive unit. (Excluding the delay of the gate resistors.)
7) Duration of blocking the command input (keeping the gate driver and the IGBT in the off-state) after fault detection, i.e. power supply under-voltage lock out, or – only in 2-level mode – short-circuit detection. (For three/multilevel mode, turn-off under the short-circuit condition is managed by the host controller.)
8) The gate current is limited by on-board gate resistors.
9) Refers to the direct output of the gate drive unit. (Excluding the delay of the gate resistors.)
10) Maximum continuous or repeatedly applied DC voltage or peak value of the repeatedly applied AC voltage between the power supply inputs and all other terminals.
11) Including the delay of external fiber-optic links. Measured from turn-on transition at direct output of the gate drive unit (excluding the delay of the gate resistors) to the transition of the status signal at the optical receiver on the host controller side.
12) Application-specific self-heating of gate drivers and IGBT modules, especially at high switching frequency, must be taken into account. The switching frequency is commonly limited due to switching losses of the IGBT modules. Because CONCEPT cannot predict how the drivers will be incorporated in the user’s application, no binding recommended value for self-heating and thus for the maximum useable output power can be made. It is therefore recommended to check the gate driver’s ambient temperature within the system.
13) Including the delay of external fiber-optic links. Measured from the transition of turn-on or turn-off command at the optical transmitter on the host controller side to direct output of the gate drive unit. (Excluding the delay of the gate resistors.)
14) Including the delay of external fiber-optic links. Measured from the transition of turn-on or turn-off command at the optical transmitter on the host controller side to the transition of the acknowledge signal at the optical receiver on the host controller side.

15) The test voltage may be applied only once during one minute. It should be noted that with this (strictly speaking obsolete) test method, some (minor) damage occurs to the insulation layers due to the partial discharge. Consequently, this test is not performed at CONCEPT as a series test. In the case of repeated insulation tests (e.g. module test, equipment test, system test) the subsequent tests should be performed with a lower test voltage: the test voltage is reduced by 10% for each additional test. The more modern if more elaborate partial-discharge measurement is better suited than such test methods as it is almost entirely non-destructive.
16) The transceivers required at the host controller side are not delivered with the gate driver. It is recommended to use the same types as used in the gate driver. For product information refer to www.IGBT-Driver.com/go/fiberoptics
17) The customer-side connector is not supplied with the gate driver, but via FCI Inc. Recommended crimp contact housing: order code 65039-032; recommended crimp contacts: 5 pcs, order code 48236-002. Refer to www.IGBT-Driver.com/go/fci
18) The recommended transmitter current at the host controller is 30-35mA, suitable for plastic optic fibers with a length of less than 2.5 meters. Higher current may increase jitter or delay at turn-off.
19) The transmitter current at the gate driver is 30-35mA.
20) The recommended transmitter current at the host controller is 60mA.
21) The transmitter current at the gate driver is about 49mA.
22) With “yes”, a di/dt feedback reduces the di/dt of the IGBT at turn-off. For more information refer to the “Description and Application Manual for 1SD536F2 SCALE High-Power IGBT Drivers”. With “no”, no di/dt feedback is implemented.

## Important Notice

The data contained in this product data sheet is intended exclusively for technically trained staff. Handling all high-voltage equipment involves risk to life. Strict compliance with the respective safety regulations is mandatory!

Any handling of electronic devices is subject to the general specifications for protecting electrostatic-sensitive devices according to international standard IEC 747-1, Chapter IX or European standard EN 100015 (i.e. the workplace, tools, etc. must comply with these standards). Otherwise, this product may be damaged.

## Disclaimer

This data sheet specifies devices but cannot promise to deliver any specific characteristics. No warranty or guarantee is given – either expressly or implicitly – regarding delivery, performance or suitability.

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## Ordering Information

The general terms and conditions of delivery of CT-Concept Technologie AG apply.

| Related IGBT | CONCEPT Driver Type # |
|---|---|
| Fuji 1MBI1600U4C-120 | 1SD536F2-1MBI1600U4C-120 |
| Fuji 1MBI1600U4C-120 | 1SD536F2-1MBI1600U4C-120 Opt. 01 |

Opt. 01: ST Fiber-optic interface (HFBR-2412Z and HFBR-1412Z), see "Description and Application Manual for 1SD536F2 SCALE High-Power IGBT Drivers".

## Information about Other Products

### For drivers adapted to other high-voltage or high-power IGBT modules

Direct link: www.IGBT-Driver.com/go/plug-and-play

### For other drivers and evaluation systems

Please click: www.IGBT-Driver.com

## Manufacturer

CT-Concept Technologie AG
Intelligent Power Electronics
Renferstrasse 15
CH-2504 Biel-Bienne
Switzerland

Tel. +41 - 32 - 344 47 47
Fax +41 - 32 - 344 47 40

E-mail Info@IGBT-Driver.com
Internet www.IGBT-Driver.com

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