# LEGM40BE120E2H7

## IGBT Power Module

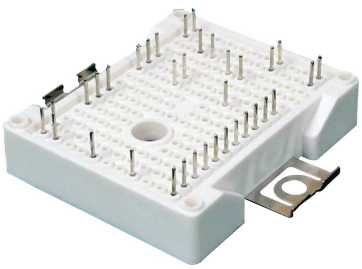
### Features:

- $V_{CE}$=1200V $I_C$=40A
- Low $V_{CE(sat)}$
- $V_{CEsat}$ with positive temperature coefficient
- Overload operation up to 175℃
- Isolation Type Package

### Applications:

- Auxiliary Inverters
- Air Conditioning
- Motor Drives

### Package Type & Internal Circuit



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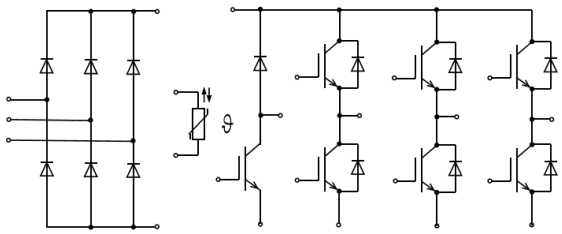


Internal Circuit

### Maximum Rated Values (IGBT Inverter)

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | $V_{EC}$=0V,$I_C$=1mA,$T_{vj}$=25℃ | 1200 | V |
| $I_C$ | Continuous Collector Current | $T_C$=100℃ | 40 | A |
| $I_{CRM}$ | Peak Collector Current | $I_{CRM}$=2$I_C$ | 80 | A |
| $V_{GES}$ | Gate-Emitter Voltage | $T_{vj}$=25℃ | ±20 | V |
| $P_{tot}$ | Total Power Dissipation | $T_C$=25℃,$T_{vjmax}$=175℃ | 259 | W |

## Characteristics Values (IGBT Inverter)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$=40 A, $V_{GE}$=15 V, $T_{vj}$=25 ℃ | | 1.68 | | V |
| | | $I_C$=40 A, $V_{GE}$=15 V, $T_{vj}$=175 ℃ | | 2.08 | | V |
| $V_{GE(th)}$ | Gate Threshold Voltage | $I_C$=1.5 mA,$V_{CE}$=$V_{GE}$,$T_{vj}$= 25 ℃ | 5.5 | 6.1 | 7.0 | V |
| $I_{CES}$ | Collector-Emitter Cut-off Current | $V_{CE}$=1200 V, $V_{GE}$=0 V, $T_{vj}$=25 ℃ | | | 1.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{CE}$=0 V, $V_{GE}$=20 V, $T_{vj}$=25 ℃ | | | 500 | nA |
| $C_{ies}$ | Input capacitance | f = 1 MHz, $T_{vj}$= 25°C, $V_{CE}$ = 25 V, $V_{GE}$= 0 V | | 3.13 | | nF |
| $C_{oes}$ | Output capacitance | | | 0.17 | | nF |
| $C_{res}$ | Reverse transfer capacitance | | | 0.09 | | nF |
| $t_{d(on)}$ | Turn-on Delay Time, Inductive Load | $I_C$=40 A,$V_{CE}$=600 V, $V_{GE}$=±15 V, $R_G$=20 Ω, $T_{vj}$=25 ℃ | | 57.8 | | ns |
| $t_r$ | Rise Time, Inductive Load | | | 41.8 | | ns |
| $t_{d(off)}$ | Turn-off Delay Time, Inductive Load | | | 307 | | ns |
| $t_f$ | Fall Time, Inductive Load | | | 178 | | ns |
| $E_{on}$ | Turn-on Energy Loss per Pulse | | | 2.33 | | mJ |
| $E_{off}$ | Turn-off Energy Loss per Pulse | | | 3.54 | | mJ |
| $t_{d(on)}$ | Turn-on Delay Time, Inductive Load | $I_C$=40 A,$V_{CE}$=600 V, $V_{GE}$=±15 V, $R_G$=20 Ω, $T_{vj}$=175 ℃ | | 49 | | ns |
| $t_r$ | Rise Time, Inductive Load | | | 42 | | ns |
| $t_{d(off)}$ | Turn-off Delay Time, Inductive Load | | | 335 | | ns |
| $t_f$ | Fall Time, Inductive Load | | | 359 | | ns |
| $E_{on}$ | Turn-on Energy Loss per Pulse | | | 3.93 | | mJ |
| $E_{off}$ | Turn-off Energy Loss per Pulse | | | 4.91 | | mJ |
| $R_{thJC}$ | Thermal resistance, junction to case | per IGBT | | | 0.58 | K/W |
| $T_{vj\ op}$ | Temperature under switching conditions | | -40 | | 175 | ℃ |
| $I_{sc}$ | SC | $V_{GE}$≤15V, $V_{CE}$≤600V,$t_p$≤10μs, $T_{vj}$=25℃,$V_{CES}$≤1200V | | 174 | | A |

## Maximum Rated Values (Diode Inverter)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | $T_{vj}$= 25 ℃ | | 1200 | | V |
| $I_F$ | Continuous DC Forward Current | $T_C$=100 ℃ | | 40 | | A |
| $I_{FRM}$ | Repetitive Peak Forward Current | $t_P$=1 ms | | 80 | | A |

## Characteristic Values (Diode Inverter)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=40 A, $V_{CE}$=0 V, $T_{vj}$=25 ℃ | | 2.31 | | V |
| | | $I_F$=40 A, $V_{CE}$=0 V, $T_{vj}$=175 ℃ | | 1.74 | | V |
| $I_{rr}$ | Peak reverse recovery current | $I_F$=40 A,$V_R$=600 V<br>-di/dt=893 A/us<br>$T_{vj}$=25 ℃ | | 13.6 | | A |
| $Q_r$ | Recovered Charge | | | 0.89 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 0.09 | | mJ |
| $I_{rr}$ | Peak reverse recovery current | $I_F$=40 A,$V_R$=600 V<br>-di/dt=893 A/us<br>$T_{vj}$=175 ℃ | | 40.8 | | A |
| $Q_r$ | Recovered Charge | | | 5.02 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 1.57 | | mJ |
| $R_{thJC}$ | Thermal resistance, junction to case | | | | 0.9 | K/W |
| $T_{vj\ op}$ | Temperature under switching conditions | | -40 | | 175 | ℃ |

## Maximum Rated Values (Diode Rectifier)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{RRM}$ | Repetitive peak reverse voltage | $T_{vj}$=25 ℃ | | 1800 | | V |
| $I_{FRMSM}$ | Maximum RMS forward current per chip | $T_c$=80 ℃ | | 60 | | A |
| $I_{RMSM}$ | Maximum RMS current at rectifier chip | $T_c$=80 ℃ | | 60 | | A |
| $I_{FSM}$ | Surge forward current | $t_p$=10ms $T_{vj}$=150 ℃ | | 370 | | A |
| $I^2t$ | $I^2t$-value | | | 685 | | $A^2S$ |

## Characteristic Values (Diode Rectifier)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward voltage | $T_{vj}$=25 ℃ $I_F$=35A | | 1.57 | | V |
| $I_R$ | Reverse current | $T_{vj}$=25 ℃ $V_R$=1800V | | | 10 | μA |
| $R_{thjc}$ | Thermal resistance junction to case | per diode | | 1.05 | 1.15 | K/W |
| $T_{vjop}$ | Temperature under switching conditions | | -40 | | 150 | ℃ |

## Maximum Rated Values (IGBT Brake-Chopper)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | $T_{vj}$=25℃ | | 1200 | | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 100℃ | | 40 | | A |
| $I_{CRM}$ | Peak Collector Current | $I_{CRM}$=2$I_C$ | | 80 | | A |
| $V_{GES}$ | Gate-Emitter Voltage | $T_{vj}$=25℃ | -20 | | 20 | V |

## Characteristic Values (IGBT Brake-Chopper)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$=40 A, $V_{GE}$=15 V, $T_{vj}$=25 ℃ | | 1.68 | | V |
| | | $I_C$=40 A, $V_{GE}$=15 V, $T_{vj}$=175 ℃ | | 2.08 | | V |
| $V_{GE(th)}$ | Gate Threshold Voltage | $I_C$=1.5 mA,$V_{CE}$=$V_{GE}$,$T_{vj}$= 25 ℃ | 5.5 | 6.1 | 7.0 | V |
| $I_{CES}$ | Collector-Emitter Cut-off Current | $V_{CE}$=1200 V, $V_{GE}$=0 V, $T_{vj}$=25 ℃ | | | 1.0 | mA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{CE}$=0 V, $V_{GE}$=20 V, $T_{vj}$=25 ℃ | | | 500 | nA |
| $C_{ies}$ | Input capacitance | f = 1 MHz, $T_{vj}$= 25°C, $V_{CE}$ = 25 V, $V_{GE}$= 0 V | | 3.13 | | nF |
| $C_{oes}$ | Output capacitance | | | 0.17 | | nF |
| $C_{res}$ | Reverse transfer capacitance | | | 0.09 | | nF |
| $t_{d(on)}$ | Turn-on Delay Time, Inductive Load | $I_C$=40 A,$V_{CE}$=600 V, $V_{GE}$=±15 V, $R_G$=15 Ω, $T_{vj}$=25 ℃ | | 39 | | ns |
| $t_r$ | Rise Time, Inductive Load | | | 31 | | ns |
| $t_{d(off)}$ | Turn-off Delay Time, Inductive Load | | | 275 | | ns |
| $t_f$ | Fall Time, Inductive Load | | | 183 | | ns |
| $E_{on}$ | Turn-on Energy Loss per Pulse | | | 1.70 | | mJ |
| $E_{off}$ | Turn-off Energy Loss per Pulse | | | 3.52 | | mJ |
| $t_{d(on)}$ | Turn-on Delay Time, Inductive Load | $I_C$=40 A,$V_{CE}$=600 V, $V_{GE}$=±15 V, $R_G$=15 Ω, $T_{vj}$=175 ℃ | | 36 | | ns |
| $t_r$ | Rise Time, Inductive Load | | | 30 | | ns |
| $t_{d(off)}$ | Turn-off Delay Time, Inductive Load | | | 305 | | ns |
| $t_f$ | Fall Time, Inductive Load | | | 348 | | ns |
| $E_{on}$ | Turn-on Energy Loss per Pulse | | | 2.67 | | mJ |
| $E_{off}$ | Turn-off Energy Loss per Pulse | | | 4.96 | | mJ |

## Characteristic Values (IGBT Brake-Chopper)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $R_{thJC}$ | Thermal resistance, junction to case | per IGBT | | | 0.58 | K/W |
| $T_{vj\ op}$ | Temperature under switching conditions | | -40 | | 175 | ℃ |
| $I_{sc}$ | SC | $V_{GE}$≤15V,$V_{CE}$=600V,$t_p$≤10μs, $T_{vj}$=125℃,$V_{CES}$≤1200V | | 160 | | A |

## Maximum Rated Values (Diode Brake-Chopper)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{RRM}$ | Repetitive Peak Reverse Voltage | $T_{vj}$= 25 ℃ | | 1200 | | V |
| $I_F$ | Continuous DC Forward Current | $T_C$=100 ℃ | | 10 | | A |
| $I_{FRM}$ | Repetitive Peak Forward Current | $t_P$=1 ms | | 20 | | A |

## Characteristics (Diode Brake-Chopper)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_F$ | Forward Voltage | $I_F$=10 A, $V_{CE}$=0 V, $T_{vj}$=25 ℃ | | 1.83 | | V |
| | | $I_F$=10 A, $V_{CE}$=0 V, $T_{vj}$=175 ℃ | | 1.51 | | V |
| $I_{rr}$ | Peak reverse recovery current | $I_F$=10 A,$V_R$=600 V -di/dt=937 A/us $T_{vj}$=25 ℃ | | 23.4 | | A |
| $Q_r$ | Recovered Charge | | | 0.87 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 0.21 | | mJ |
| $I_{rr}$ | Peak reverse recovery current | $I_F$=10 A,$V_R$=600 V -di/dt=937 A/us $T_{vj}$=175 ℃ | | 30.8 | | A |
| $Q_r$ | Recovered Charge | | | 2.45 | | μC |
| $E_{rec}$ | Reverse Recovery Energy | | | 0.89 | | mJ |
| $R_{thJC}$ | Thermal resistance, junction to case | | | | 3.03 | K/W |
| $T_{vj\ op}$ | Temperature under switching conditions | | -40 | | 150 | ℃ |

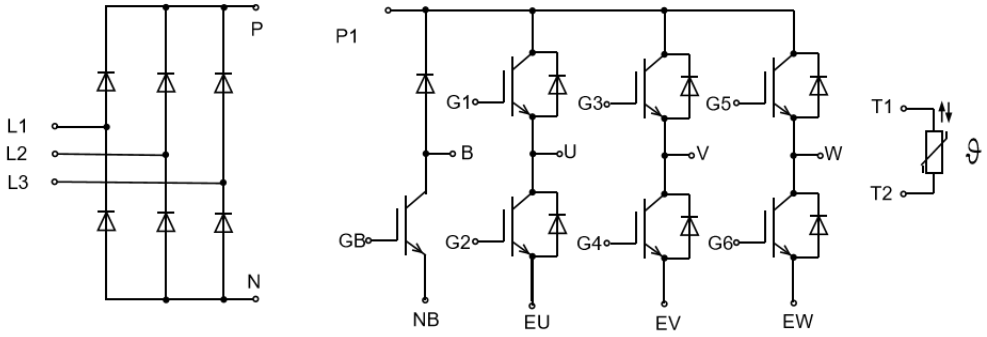
## NTC-Thermistor (Characteristic Values)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $R_{25}$ | Rated resistance | $T_c$=25 ℃ | | 5 | | KΩ |
| ΔR/R | Deviation of R100 | $T_c$=100 ℃ | -5 | | 5 | % |
| $P_{25}$ | Power dissipation | $T_c$=25 ℃ | | 20 | | mW |
| $B_{25/50}$ | B-value | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298,15K))]$ | | 3380 | | K |
| $B_{25/100}$ | B-value | $R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298,15K))]$ | | 3450 | | K |

## Module Characteristics

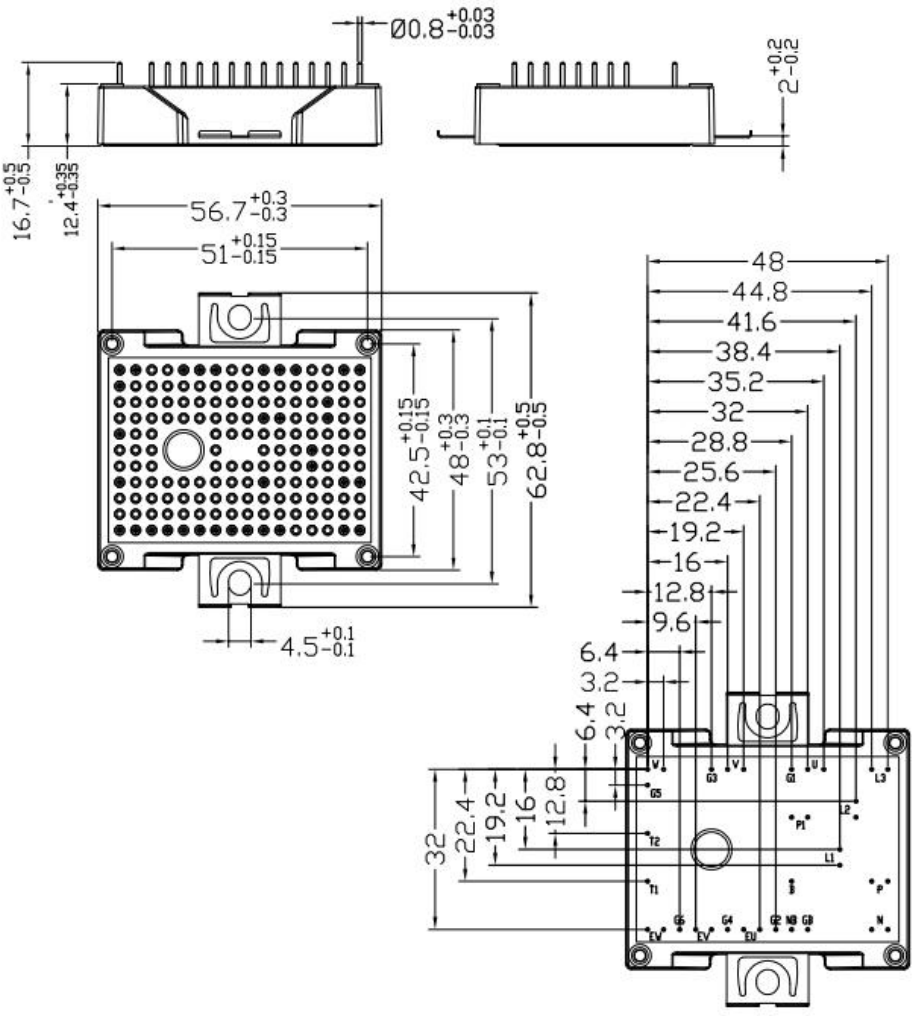
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{isol}$ | Isolation voltage | t=1min,f=50Hz | 2500 | | | V |
| $T_{stg}$ | Storage Temperature | | -40 | | 125 | ℃ |
| F | Mountig Force per Clamp | | 20 | | 50 | N |
| G | Weight of Module | | | 44 | | g |

## Circuit Diagram




## Package Dimensions

(Dimensions in Millimeters)



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2. Operating conditions may differ from simulation assumptions in several aspects like level of DC-link voltage, applied gate-voltage and gate-resistor, case and junction temperatures as well as the power circuit stray-inductance. Therefore, deviations of parameters and assumptions used for the simulation and the real application may exist.
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