

Trench gate field-stop IGBT, M series 1200 V, 8 A low-loss

Datasheet - production data

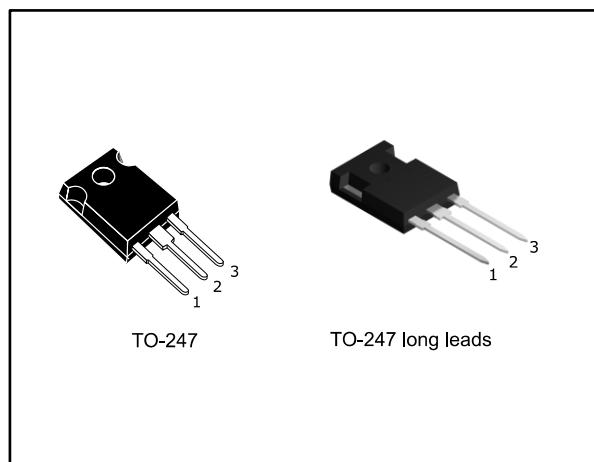
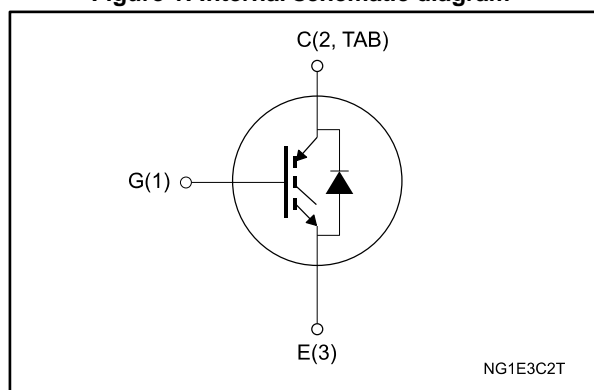


Figure 1: Internal schematic diagram



Features

- 10 μ s of short-circuit withstand time
- $V_{CE(sat)} = 1.85$ V (typ.) @ $I_C = 8$ A
- Tight parameter distribution
- Safer paralleling
- Low thermal resistance
- Soft and very fast recovery antiparallel diode

Applications

- Industrial drives
- UPS
- Solar
- Welding

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where low-loss and short-circuit functionality are essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and tight parameter distribution result in safer paralleling operation.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|---------------|-----------|-------------------|---------|
| STGW8M120DF3 | G8M120DF3 | TO-247 | Tube |
| STGWA8M120DF3 | | TO-247 long leads | |

Contents

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1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|--|------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$ V) | 1200 | V |
| I_C | Continuous collector current at $T_C = 25$ °C | 16 | A |
| I_C | Continuous collector current at $T_C = 100$ °C | 8 | A |
| $I_{CP}^{(1)}$ | Pulsed collector current | 32 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| I_F | Continuous forward current at $T_C = 25$ °C | 16 | A |
| I_F | Continuous forward current at $T_C = 100$ °C | 8 | A |
| $I_{FP}^{(1)}$ | Pulsed forward current | 32 | A |
| P_{TOT} | Total dissipation at $T_C = 25$ °C | 167 | W |
| T_{STG} | Storage temperature range | -55 to 150 | °C |
| T_J | Operating junction temperature range | -55 to 175 | °C |

Notes:

⁽¹⁾Pulse width limited by maximum junction temperature.

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|------------|--|-------|------|
| R_{thJC} | Thermal resistance junction-case IGBT | 0.9 | °C/W |
| R_{thJC} | Thermal resistance junction-case diode | 1.47 | °C/W |
| R_{thJA} | Thermal resistance junction-ambient | 50 | °C/W |

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified

Table 4: Static characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------|--|------|------|-----------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$ | 1200 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 8\text{ A}$ | | 1.85 | 2.3 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 8\text{ A}$, $T_J = 125\text{ °C}$ | | 2.1 | | |
| | | $V_{GE} = 15\text{ V}$, $I_C = 8\text{ A}$, $T_J = 175\text{ °C}$ | | 2.2 | | |
| V_F | Forward on-voltage | $I_F = 8\text{ A}$ | | 2.4 | 3.35 | V |
| | | $I_F = 8\text{ A}$, $T_J = 125\text{ °C}$ | | 1.75 | | |
| | | $I_F = 8\text{ A}$, $T_J = 175\text{ °C}$ | | 1.55 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 500\text{ }\mu\text{A}$ | 5 | 6 | 7 | V |
| I_{CES} | Collector cut-off current | $V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$ | | | 25 | μA |
| I_{GES} | Gate-emitter leakage current | $V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$ | | | ± 250 | nA |

Table 5: Dynamic characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|--|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 542 | - | pF |
| C_{oes} | Output capacitance | | - | 74.4 | - | |
| C_{res} | Reverse transfer capacitance | | - | 21 | - | |
| Q_g | Total gate charge | $V_{CC} = 960\text{ V}$, $I_C = 8\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 30: "Gate charge test circuit") | - | 32 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 4.5 | - | |
| Q_{gc} | Gate-collector charge | | - | 18.5 | - | |

Table 6: IGBT switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|------------------------------|---|------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 600\text{ V}$, $I_C = 8\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 33\ \Omega$ (see Figure 29: "Test circuit for inductive load switching") | | 20 | - | ns |
| t_r | Current rise time | | | 8.4 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 800 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | | | 126 | - | ns |
| t_f | Current fall time | | | 136 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | | 0.39 | - | mJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | | 0.37 | - | mJ |
| E_{ts} | Total switching energy | | | 0.76 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 600\text{ V}$, $I_C = 8\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 33\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 29: "Test circuit for inductive load switching") | | 19 | - | ns |
| t_r | Current rise time | | | 9.8 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 656 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | | | 134 | - | ns |
| t_f | Current fall time | | | 222 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | | 0.66 | - | mJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | | 0.58 | - | mJ |
| E_{ts} | Total switching energy | | | 1.24 | - | mJ |
| t_{sc} | Short-circuit withstand time | $V_{CC} \leq 600\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} \leq 150\text{ }^\circ\text{C}$ | 10 | | - | μ s |

Notes:

(1)Including the reverse recovery of the diode

(2)Including the tail of the collector current

Table 7: Diode switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit | |
|--------------|--|---|------|------|------|------|------------|
| t_{rr} | Reverse recovery time | $I_F = 8\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 33\ \Omega$ $(di/dt = 1000\text{ A}/\mu\text{s})$ (see Figure 29: "Test circuit for inductive load switching") | - | 103 | - | ns | |
| Q_{rr} | Reverse recovery charge | | | - | 0.87 | - | μ C |
| I_{rrm} | Reverse recovery current | | | - | 19.2 | - | A |
| dl_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | | - | 720 | - | A/ μ s |
| E_{rr} | Reverse recovery energy | | | - | 211 | - | μ J |
| t_{rr} | Reverse recovery time | $I_F = 8\text{ A}$, $V_R = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$, $R_G = 33\ \Omega$ ($di/dt = 840\text{ A}/\mu\text{s}$) (see Figure 29: "Test circuit for inductive load switching") | - | 280 | - | ns | |
| Q_{rr} | Reverse recovery charge | | | - | 1.9 | - | μ C |
| I_{rrm} | Reverse recovery current | | | - | 21.8 | - | A |
| dl_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | | - | 450 | - | A/ μ s |
| E_{rr} | Reverse recovery energy | | | - | 404 | - | μ J |

2.1 Electrical characteristics (curves)

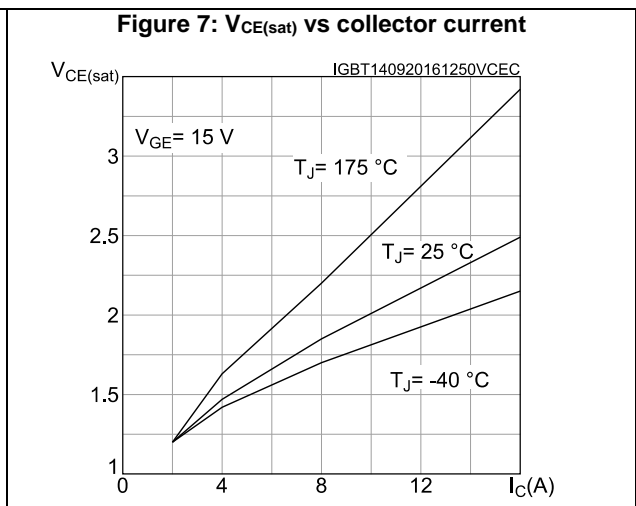
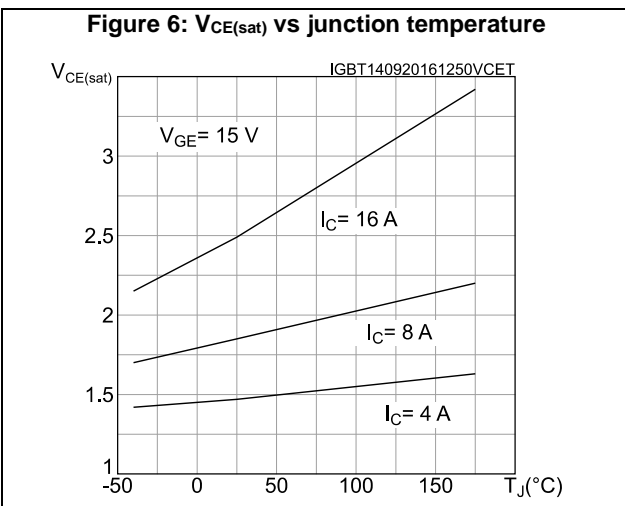
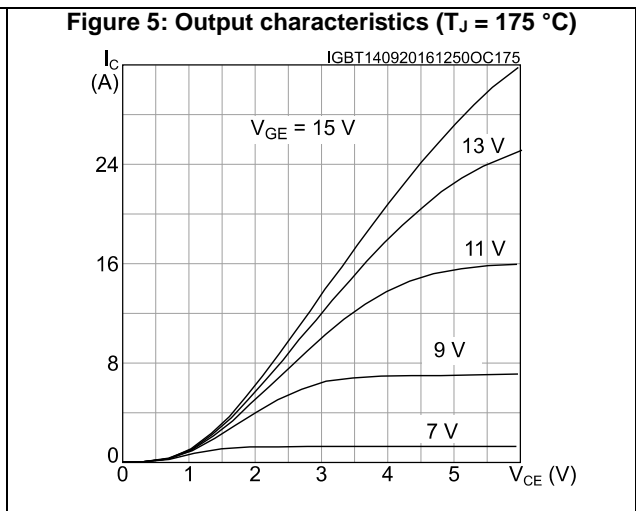
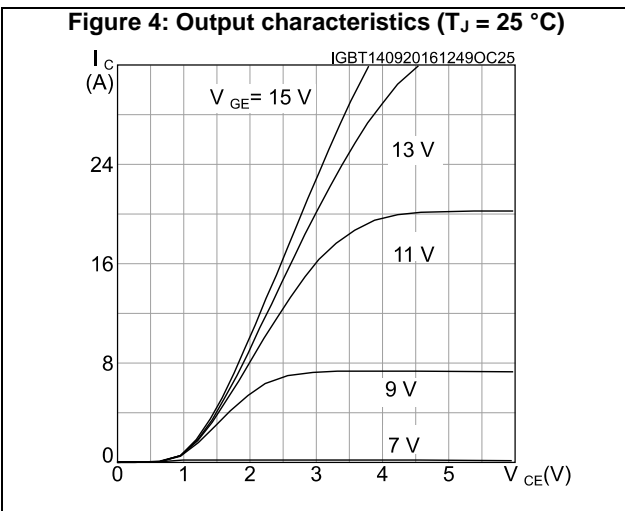
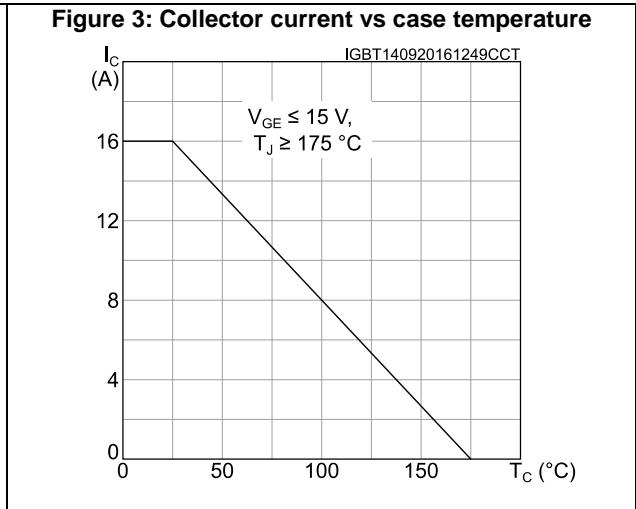
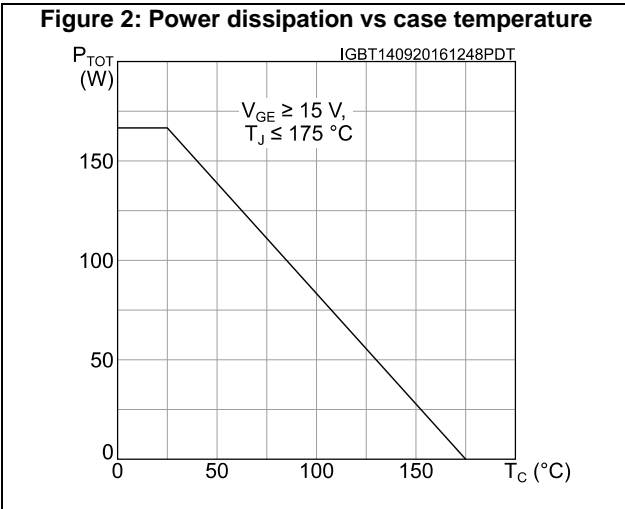


Figure 8: Collector current vs switching frequency

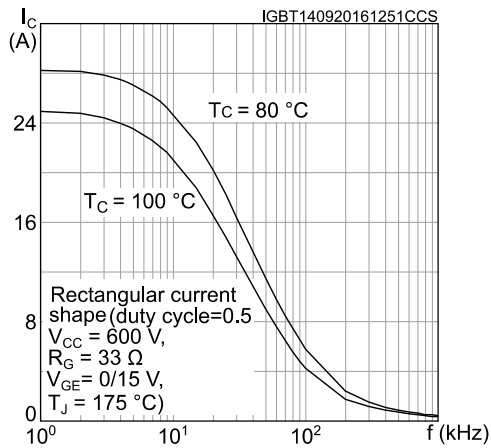


Figure 9: Forward bias safe operating area

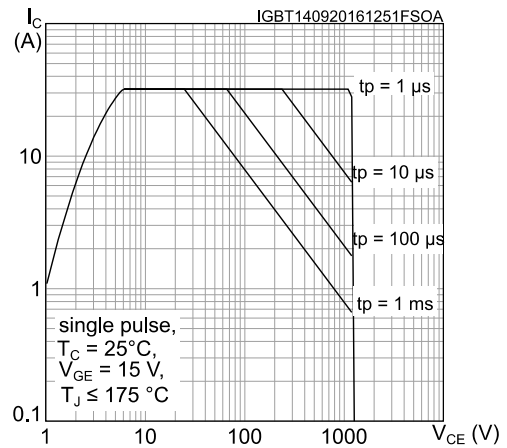


Figure 10: Transfer characteristics

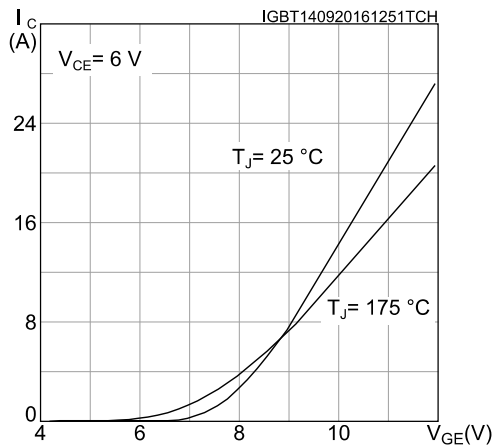


Figure 11: Diode VF vs forward current

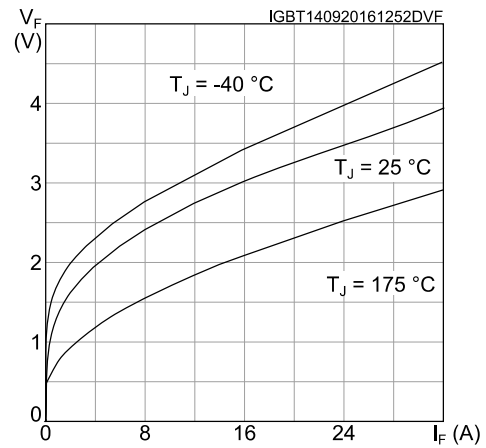


Figure 12: Normalized VGE(th) vs junction temperature

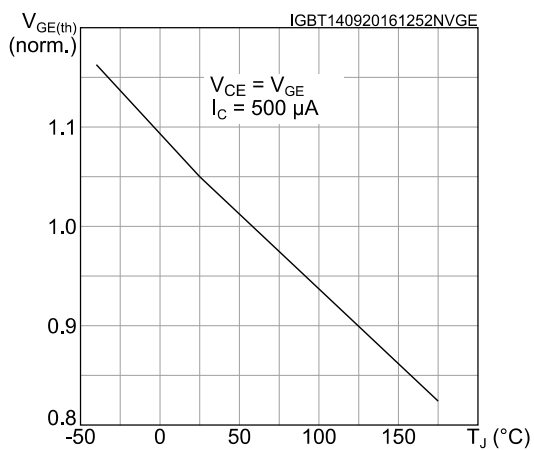
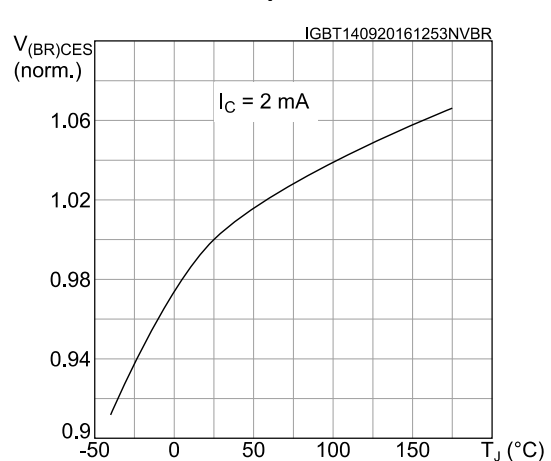


Figure 13: Normalized V(BR)CES vs junction temperature



Electrical characteristics

STGW8M120DF3, STGWA8M120DF3

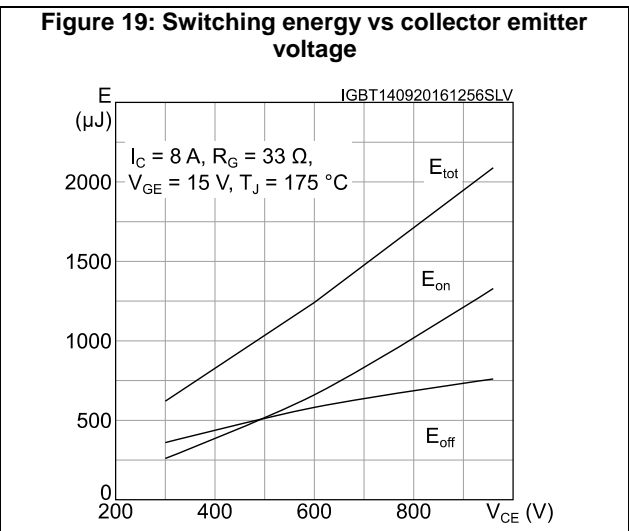
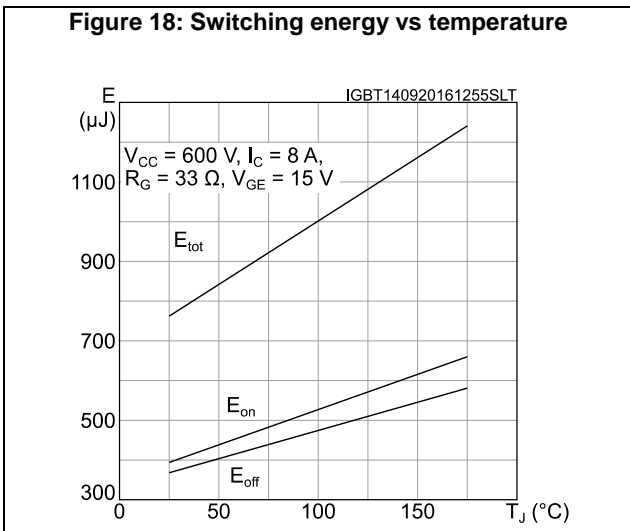
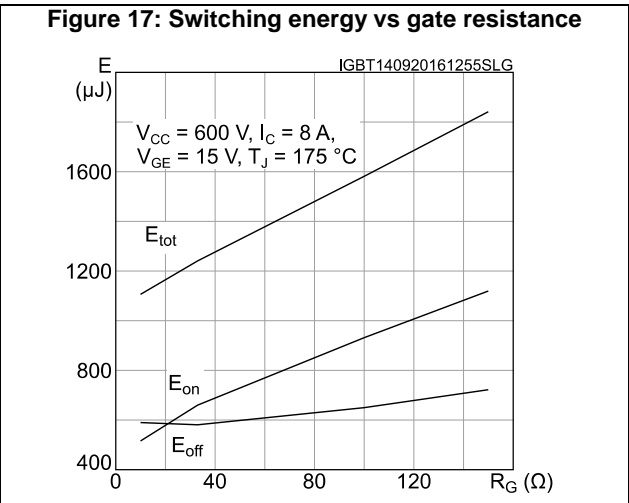
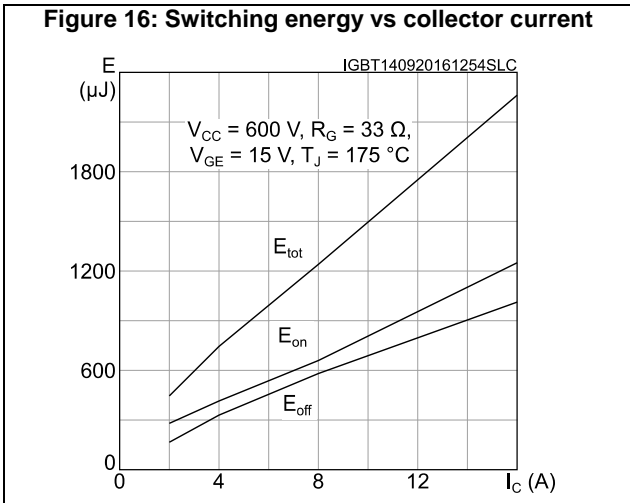
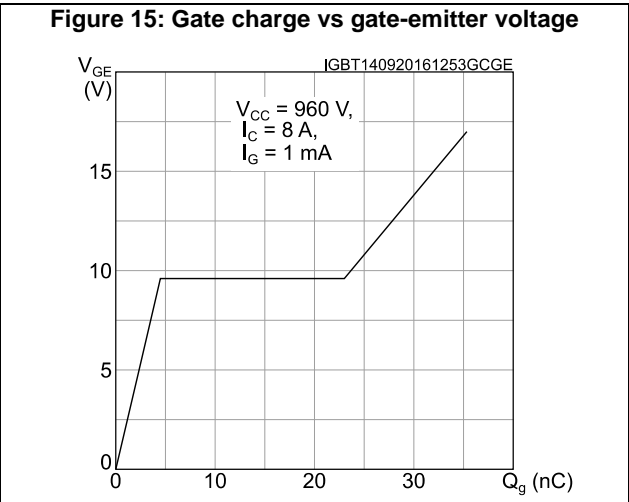
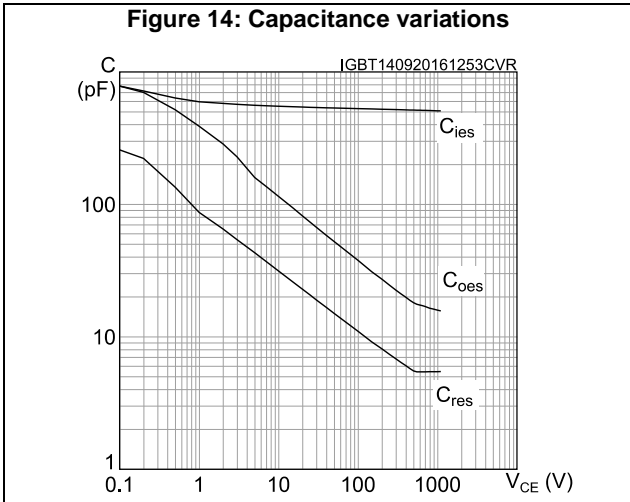


Figure 20: Short-circuit time and current vs V_{GE}

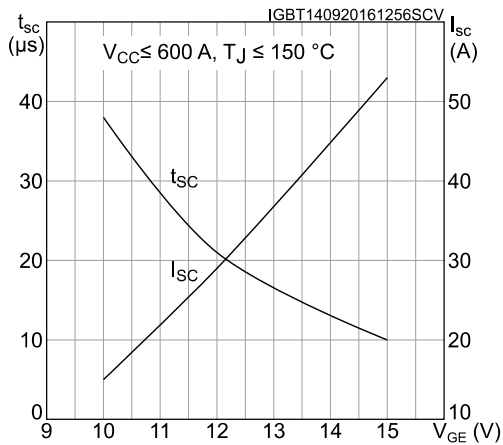


Figure 21: Switching times vs collector current

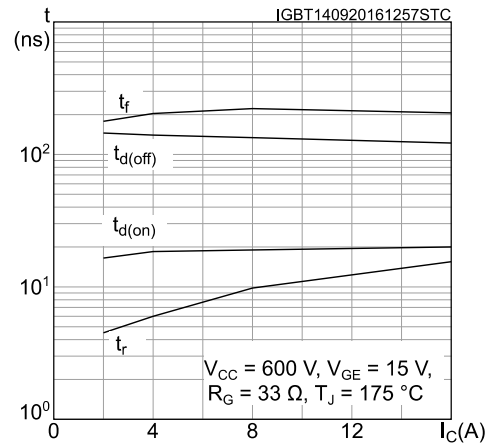


Figure 22: Switching times vs gate resistance

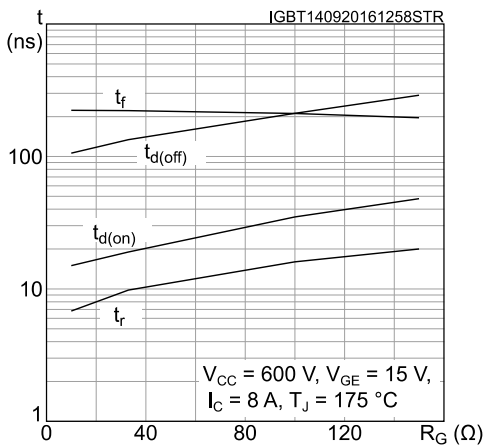


Figure 23: Reverse recovery current vs diode current slope

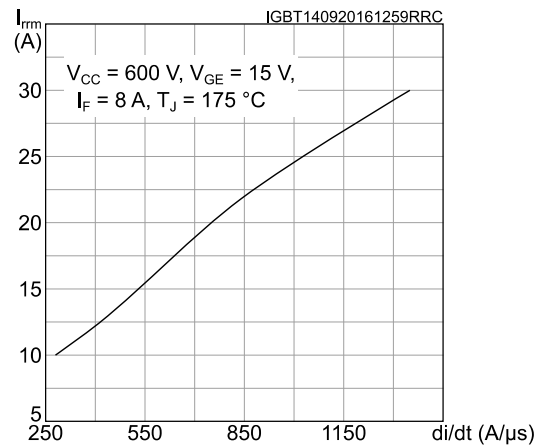


Figure 24: Reverse recovery time vs diode current slope

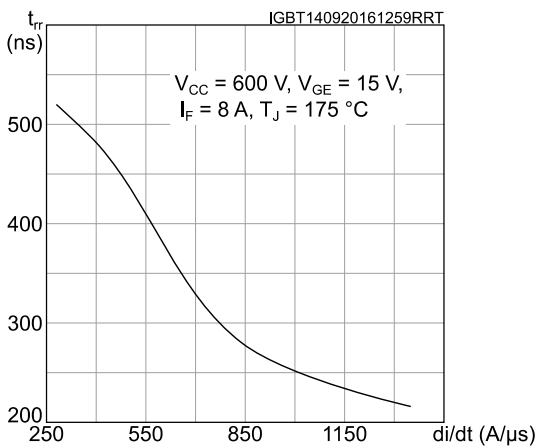


Figure 25: Reverse recovery charge vs diode current slope

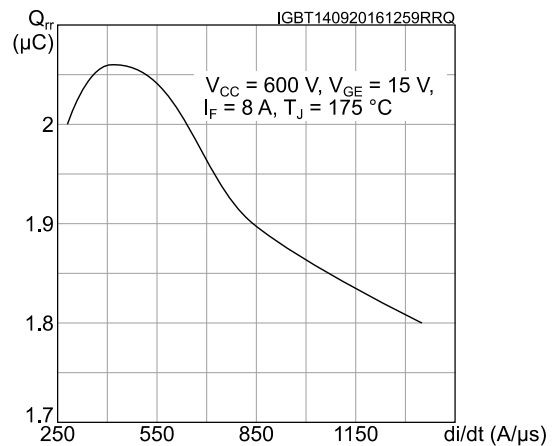


Figure 26: Reverse recovery energy vs diode current slope

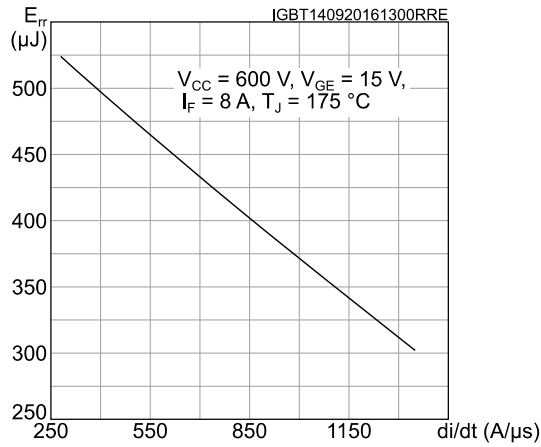


Figure 27: Thermal impedance for IGBT

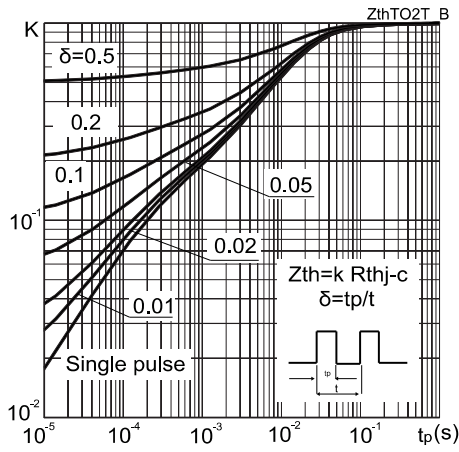
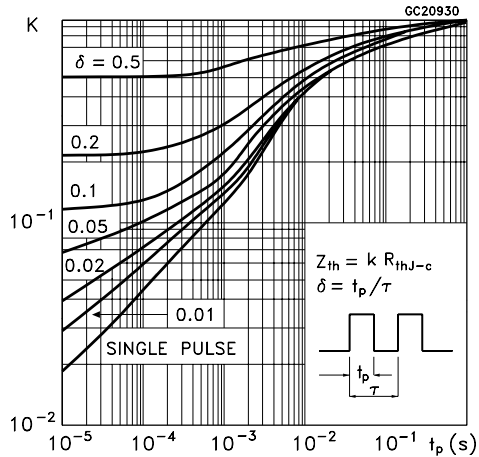
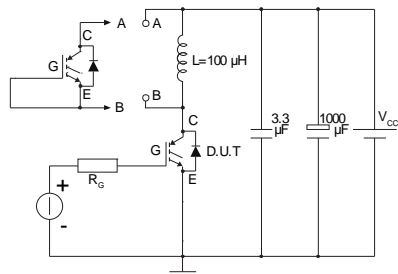


Figure 28: Thermal impedance for diode



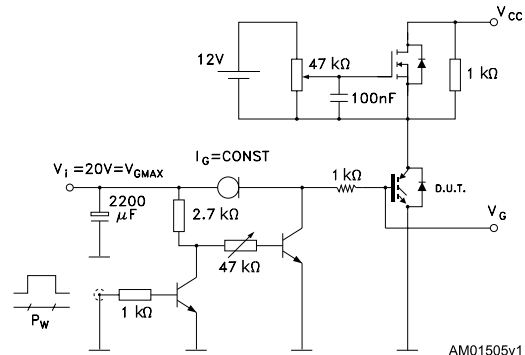
3 Test circuits

Figure 29: Test circuit for inductive load switching



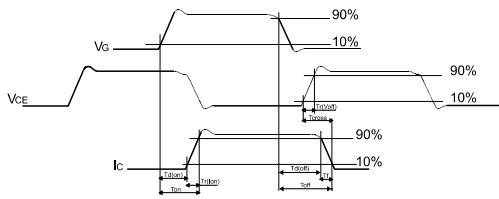
AM01504v1

Figure 30: Gate charge test circuit



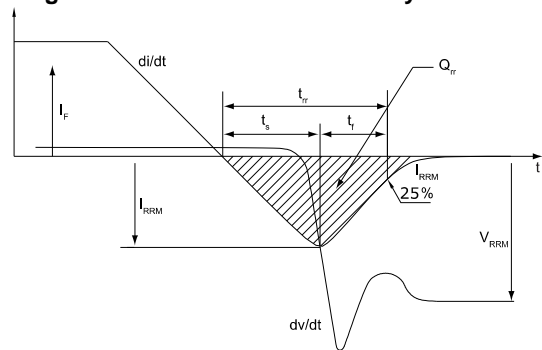
AM01505v1

Figure 31: Switching waveform



AM01506v1

Figure 32: Diode reverse recovery waveform



AM01507v1

4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

4.1 TO-247 package information

Figure 33: TO-247 package outline

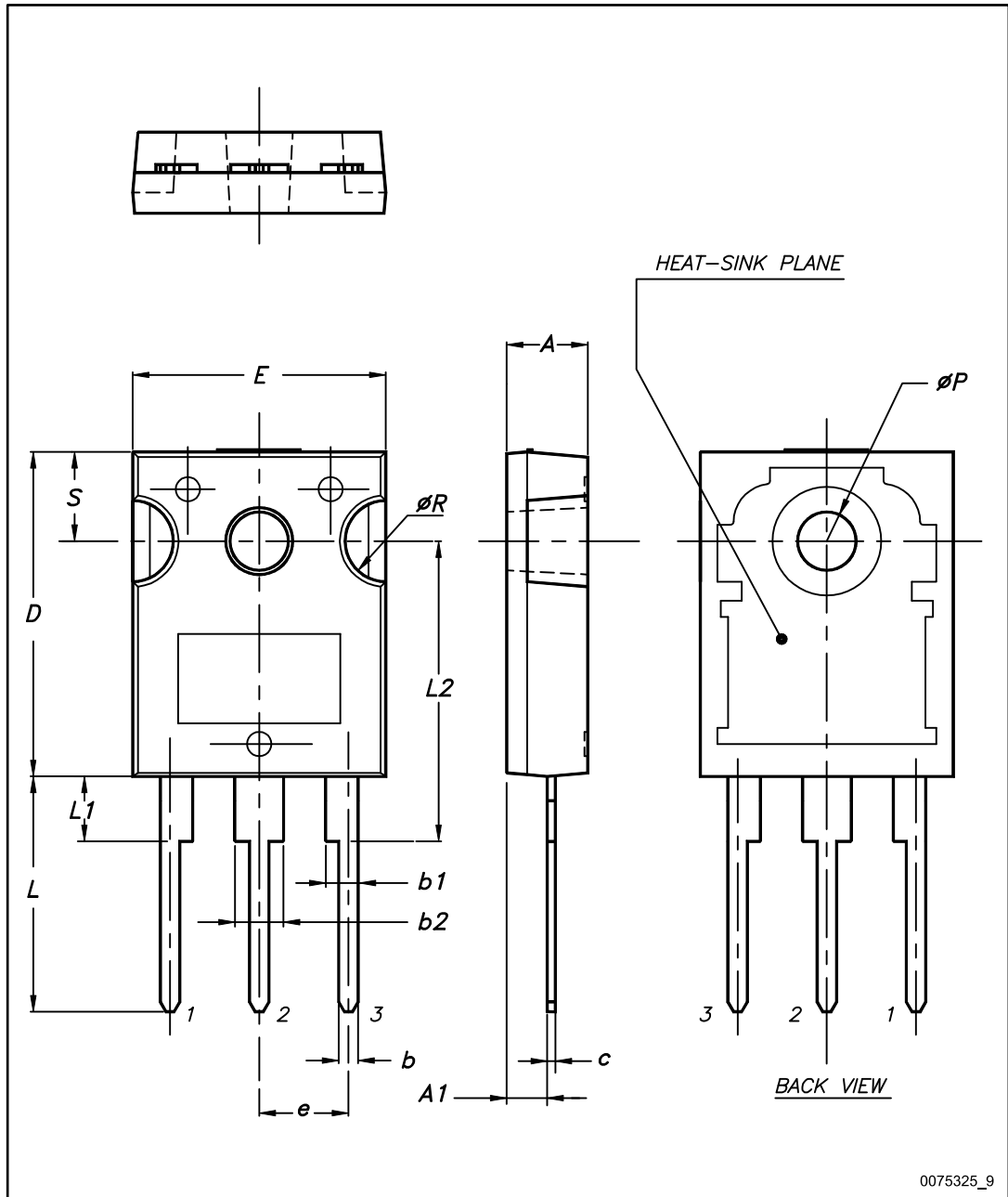


Table 8: TO-247 package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.85 | | 5.15 |
| A1 | 2.20 | | 2.60 |
| b | 1.0 | | 1.40 |
| b1 | 2.0 | | 2.40 |
| b2 | 3.0 | | 3.40 |
| c | 0.40 | | 0.80 |
| D | 19.85 | | 20.15 |
| E | 15.45 | | 15.75 |
| e | 5.30 | 5.45 | 5.60 |
| L | 14.20 | | 14.80 |
| L1 | 3.70 | | 4.30 |
| L2 | | 18.50 | |
| ØP | 3.55 | | 3.65 |
| ØR | 4.50 | | 5.50 |
| S | 5.30 | 5.50 | 5.70 |

4.2 TO-247 long leads package information

Figure 34: TO-247 long leads package outline

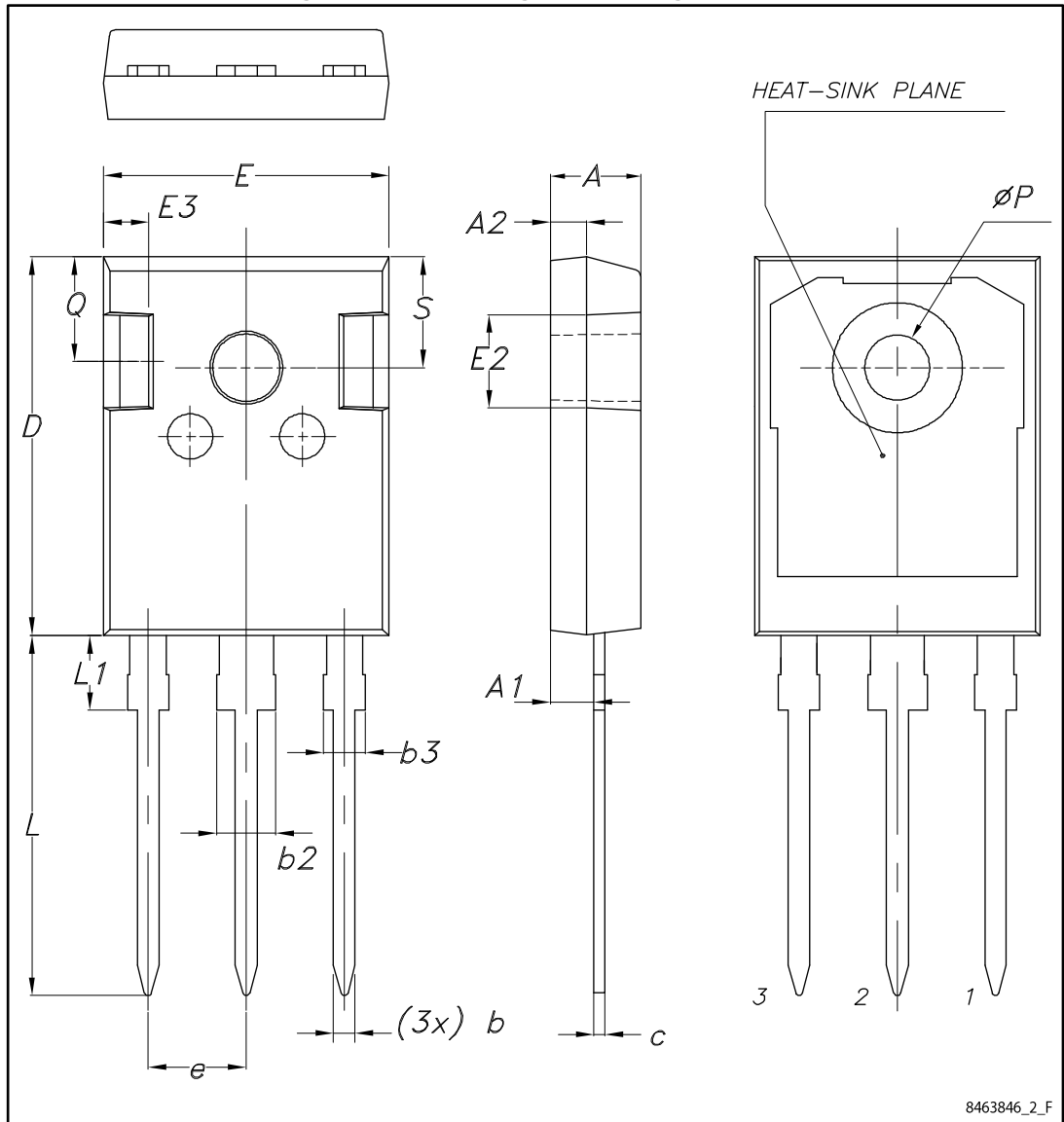


Table 9: TO-247 long leads package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.90 | 5.00 | 5.10 |
| A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.16 | | 1.26 |
| b2 | | | 3.25 |
| b3 | | | 2.25 |
| c | 0.59 | | 0.66 |
| D | 20.90 | 21.00 | 21.10 |
| E | 15.70 | 15.80 | 15.90 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 5.34 | 5.44 | 5.54 |
| L | 19.80 | 19.92 | 20.10 |
| L1 | | | 4.30 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 5.60 | | 6.00 |
| S | 6.05 | 6.15 | 6.25 |

5 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 11-May-2016 | 1 | First release. |
| 19-Sep-2016 | 2 | Datasheet promoted from preliminary to production data. Updated <i>Table 2: "Absolute maximum ratings"</i> . Updated <i>Section 2: "Electrical characteristics"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> . |
| 31-Oct-2017 | 3 | Updated package silhouette on cover page. Updated <i>Table 4: "Static characteristics"</i> and <i>Table 5: "Dynamic characteristics"</i> . Minor text changes |

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- Техническая поддержка проекта;
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Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.