COMPLEMENTARY PAIR ENHANCEMENT MODE MOSFET

**Product Summary**

<table>
<thead>
<tr>
<th>Device</th>
<th>$V_{BRSS}$</th>
<th>$R_{DS(ON)}$ max</th>
<th>$I_D$ max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>30V</td>
<td>1.5Ω@ $V_{GS} = 4.5V$</td>
<td>0.22A</td>
</tr>
<tr>
<td>Q1</td>
<td>30V</td>
<td>2.0Ω@ $V_{GS} = 2.5V$</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>30V</td>
<td>3.0Ω@ $V_{GS} = 1.8V$</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>30V</td>
<td>4.5Ω@ $V_{GS} = 1.5V$</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>-30V</td>
<td>5Ω@ $V_{GS} = -4.5V$</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>-30V</td>
<td>6Ω@ $V_{GS} = -2.5V$</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>-30V</td>
<td>7Ω@ $V_{GS} = -1.8V$</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>-30V</td>
<td>10Ω@ $V_{GS} = -1.5V$</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

This MOSFET has been designed to minimize the on-state resistance ($R_{DS(ON)}$) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

**Applications**

- General Purpose Interfacing Switch
- Power Management Functions
- Analog Switch

**Features and Benefits**

- Low On-Resistance
- Very low Gate Threshold Voltage, 1.0V max
- Low Input Capacitance
- Fast Switching Speed
- Ultra-Small Surface Mount Package 1mm x 1mm
- ESD Protected Gate
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. “Green” Device (Note 3)
- Qualified to AEC-Q101 standards for High Reliability

**Mechanical Data**

- Case: SOT963
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections Indicator: See Diagram
- Terminals: Finish — Matte Tin Annealed over Copper Leadframe Solderable per MIL-STD-202, Method 208 
- Weight: 0.027 grams (approximate)

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Case</th>
<th>Packaging</th>
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<tr>
<td>DMC31D5UDJ-7</td>
<td>SOT963</td>
<td>10K/Tape &amp; Reel</td>
</tr>
<tr>
<td>DMC31D5UDJ-7B</td>
<td>SOT963</td>
<td>10K/Tape &amp; Reel</td>
</tr>
</tbody>
</table>

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, “Green” and Lead-free.
3. Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at http://www.diodes.com/products/packages.html. The options -7 and -7B stand for different taping orientations.

**Marking Information**

U1 = Product Type Marking Code

DMC31D5UDJ
Document number: DS36799  Rev. 2 - 2

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# Maximum Ratings Q1 N-CHANNEL (\(T_A = +25^\circ C\), unless otherwise specified.)

- **Drain-Source Voltage**: \(V_{DSS} = 30\) V
- **Gate-Source Voltage**: \(V_{GS} = \pm 12\) V
- **Continuous Drain Current (Note 5)**: 
  - Steady State: \(I_D = 220\) mA \(T_A = +25^\circ C\)
  - \(I_D = 160\) mA \(T_A = +70^\circ C\)
- **Maximum Continuous Body Diode Forward Current (Note 6)**: \(I_S = 200\) mA
- **Pulsed Drain Current (Note 6)**: \(I_{DM} = 600\) mA

# Maximum Ratings Q2 P-CHANNEL (\(T_A = +25^\circ C\), unless otherwise specified.)

- **Drain-Source Voltage**: \(V_{DSS} = -30\) V
- **Gate-Source Voltage**: \(V_{GS} = \pm 12\) V
- **Continuous Drain Current (Note 5)**: 
  - Steady State: \(I_D = -200\) mA \(T_A = +25^\circ C\)
  - \(I_D = -140\) mA \(T_A = +70^\circ C\)
- **Maximum Continuous Body Diode Forward Current (Note 6)**: \(I_S = -200\) mA
- **Pulsed Drain Current (Note 6)**: \(I_{DM} = -600\) mA

# Thermal Characteristics (\(T_A = +25^\circ C\), unless otherwise specified.)

- **Total Power Dissipation (Note 5)**: \(P_D = 350\) mW
- **Thermal Resistance, Junction to Ambient (Note 5)**: \(R_{JA} = 361\) °C/W
- **Operating and Storage Temperature Range**: 
  - \(T_J, T_{STG} = -55\) to +150 °C

# Electrical Characteristics Q1 N-CHANNEL (\(T_A = +25^\circ C\), unless otherwise specified.)

### OFF CHARACTERISTICS (Note 7)
- **Drain-Source Breakdown Voltage**: \(B_{VDS} = 30\) V
- **Zero Gate Voltage Drain Current**: 
  - \(I_{DSS} = 100\) nA \(V_{DS} = 24\) V, \(V_{GS} = 0\) V
- **Gate-Source Leakage**: \(I_{GS} = \pm 10\) µA

### ON CHARACTERISTICS (Note 7)
- **Gate Threshold Voltage**: 
  - \(V_{GS(TH)} = 0.4\) V
- **Static Drain-Source On-Resistance**: 
  - \(R_{DS(ON)} = 0.9\) Ω ~ 1.5 Ω
  - \(1.0\) Ω ~ 2.0 Ω
  - \(1.2\) Ω ~ 3.0 Ω
  - \(1.4\) Ω ~ 4.5 Ω
  - \(2.3\) Ω
- **Diode Forward Voltage**: \(V_{SD} = 0.6\) V ~ 1.0 V

### DYNAMIC CHARACTERISTICS (Note 8)
- **Input Capacitance**: 
  - \(C_{iss} = 22.6\) pF
- **Output Capacitance**: 
  - \(C_{oss} = 2.68\) pF
- **Reverse Transfer Capacitance**: 
  - \(C_{rss} = 1.8\) pF
- **Total Gate Charge**: 
  - \(Q_G = 0.38\) nC
- **Gate-Source Charge**: 
  - \(Q_{GS} = 0.05\) nC
- **Gate-Drain Charge**: 
  - \(Q_{GD} = 0.07\) nC
- **Turn-On Delay Time**: 
  - \(t_{(ON)} = 3.2\) ns
- **Turn-On Rise Time**: 
  - \(t_r = 2.2\) ns
- **Turn-Off Delay Time**: 
  - \(t_{(OFF)} = 21\) ns
- **Turn-Off Fall Time**: 
  - \(t_f = 7.5\) ns
## Electrical Characteristics Q2 P-CHANNEL (@TA = +25°C, unless otherwise specified.)

<table>
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<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Condition</th>
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<tr>
<td><strong>OFF CHARACTERISTICS (Note 7)</strong></td>
<td></td>
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<tr>
<td>Drain-Source Breakdown Voltage</td>
<td>BVDSS</td>
<td>-30</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>VGS = 0V, ID = -250μA</td>
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<tr>
<td>Zero Gate Voltage Drain Current @TC = +25°C</td>
<td>IDSS</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>nA</td>
<td>VDS = -24V, VGS = 0V</td>
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<tr>
<td>Gate-Source Leakage</td>
<td>IGS</td>
<td>—</td>
<td>—</td>
<td>±10</td>
<td>μA</td>
<td>VGS = ±10V, VDS = 0V</td>
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<tr>
<td><strong>ON CHARACTERISTICS (Note 7)</strong></td>
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<tr>
<td>Gate Threshold Voltage</td>
<td>VGS(th)</td>
<td>-0.4</td>
<td>—</td>
<td>-1.0</td>
<td>V</td>
<td>VGS = VDS, ID = -250μA</td>
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<tr>
<td>Static Drain-Source On-Resistance</td>
<td>RDS(ON)</td>
<td>—</td>
<td>2.0</td>
<td>5</td>
<td>Ω</td>
<td>VGS = -4.5V, ID = -100mA</td>
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<td>VGS = -2.5V, ID = -50mA</td>
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<td>7</td>
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<td>VGS = -1.8V, ID = -20mA</td>
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<td>—</td>
<td>3.4</td>
<td>10</td>
<td></td>
<td>VGS = -1.5V, ID = -10mA</td>
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<td>—</td>
<td>5.1</td>
<td>—</td>
<td></td>
<td>VGS = -1.2V, ID = -1mA</td>
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<tr>
<td>Diode Forward Voltage</td>
<td>VSD</td>
<td>—</td>
<td>-0.6</td>
<td>-1.0</td>
<td>V</td>
<td>VGS = 0V, IS = -10mA</td>
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<tr>
<td><strong>DYNAMIC CHARACTERISTICS (Note 8)</strong></td>
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<tr>
<td>Input Capacitance</td>
<td>Ciss</td>
<td>—</td>
<td>21.8</td>
<td>—</td>
<td>pF</td>
<td>VDS = -15V, VGS = 0V, f = 1.0MHz</td>
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<tr>
<td>Output Capacitance</td>
<td>Coss</td>
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<td>2.82</td>
<td>—</td>
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<tr>
<td>Reverse Transfer Capacitance</td>
<td>Crss</td>
<td>—</td>
<td>1.66</td>
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<td>Total Gate Charge</td>
<td>Qg</td>
<td>—</td>
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<td>—</td>
<td>nC</td>
<td>VGS = -4.5V, VDS = -15V, ID = -200mA</td>
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<tr>
<td>Gate-Source Charge</td>
<td>Qgs</td>
<td>—</td>
<td>0.05</td>
<td>—</td>
<td>nC</td>
<td></td>
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<tr>
<td>Gate-Drain Charge</td>
<td>Qgd</td>
<td>—</td>
<td>0.10</td>
<td>—</td>
<td>nC</td>
<td></td>
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<tr>
<td>Turn-On Delay Time</td>
<td>tD(on)</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
<td>ns</td>
<td>VDD = -15V, VGS = -4.5V, Rg = 2Ω, ID = -200mA</td>
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<tr>
<td>Turn-On Rise Time</td>
<td>tR</td>
<td>—</td>
<td>5.2</td>
<td>—</td>
<td>ns</td>
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<tr>
<td>Turn-Off Delay Time</td>
<td>tD(off)</td>
<td>—</td>
<td>18.8</td>
<td>—</td>
<td>ns</td>
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</tr>
<tr>
<td>Turn-Off Fall Time</td>
<td>tF</td>
<td>—</td>
<td>8.7</td>
<td>—</td>
<td>ns</td>
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</tr>
</tbody>
</table>

Notes:

5. Device mounted on FR-4 PCB, with minimum recommended pad layout.
6. Device mounted on minimum recommended pad layout test board, 10μs pulse duty cycle = 1%.
7. Short duration pulse test used to minimize self-heating effect.
8. Guaranteed by design. Not subject to product testing.
Figure 1  Typical Output Characteristics

Figure 2  Typical Transfer Characteristics

Figure 3  Typical On-Resistance vs. Drain Current and Gate Voltage

Figure 4  Typical On-Resistance vs. Drain Current and Temperature

Figure 5 On-Resistance Variation with Temperature

Figure 6 On-Resistance Variation with Temperature
Figure 7  Gate Threshold Variation vs. Ambient Temperature

Figure 8  Diode Forward Voltage vs. Current

Figure 9  Typical Junction Capacitance

Figure 10  Gate Charge
Figure 1  Typical Output Characteristics

Figure 2  Typical Transfer Characteristics

Figure 3  Typical On-Resistance vs. Drain Current and Gate Voltage

Figure 4  Typical On-Resistance vs. Drain Current and Temperature

Figure 5  On-Resistance Variation with Temperature

Figure 6  On-Resistance Variation with Temperature
Figure 7  Gate Threshold Variation vs. Ambient Temperature

Figure 8  Diode Forward Voltage vs. Current

Figure 9  Typical Junction Capacitance

Figure 10  Gate-Charge Characteristics

Figure 11  Transient Thermal Resistance
Package Outline Dimensions

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

<table>
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<th>Dimensions</th>
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<tr>
<td>X</td>
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<tr>
<td>Y</td>
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<td>Y1</td>
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SOT963

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</table>

All Dimensions in mm

Suggested Pad Layout

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