The DM4031 is an ultra-wideband phase delay fabricated using 1-um HBT GaAs technology and is based on ECL topology to guarantee high-speed operation. The high output voltage, excellent rise and fall time, and the high eye diagram quality at data rates to 12.5 Gb/s makes the DM4031 suitable for timing adjustment in data and clock distribution at very high speed. Complex digital applications benefit from the DM4031, including clock data recovery, edge detectors, NRZ-to-RZ converters, MUX/DEMUX, and data restoration. The device features a single delay element that provides up to 100-ps delay. Delay control can be either differential (using both VCp and VCm) or single-ended (VCm is the active control pad while VCp is shorted to VCre). The control voltage range for the delay input is from -2.2 V to -3.0 V whether the control is single-ended or differential. The device can delay NRZ streams with data rates to 12.5 Gb/s or a clock signal up to 10.7 GHz. Both inputs and outputs are DC-coupled. At the input side, internal 50-ohm resistors avoid the need for external impedance matching terminations. The DM4031 uses SCFL I/O levels and is designed so to allow for either single ended or differential data input.

- Ultra wideband: Up to 12.5 Gb/s NRZ
- Delay adjustment to 100 ps
- 900 mVpp single-ended output
- Jitter RMS: <1.5 ps
- Output rise time (20% – 80 %): <25 ps
- Output fall time (20% – 80 %): <23 ps
- 50-ohm matched DC-coupled inputs and outputs
- Differential or single ended I/O
- Power consumption: 1.65 W
### Absolute Maximum Ratings

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this document is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters/conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEE</td>
<td>Power supply voltage</td>
<td>-5.5</td>
<td>0</td>
<td>V</td>
</tr>
<tr>
<td>VIH</td>
<td>Input voltage level, high level</td>
<td>-1.5</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>VIL</td>
<td>Input voltage level, low level</td>
<td>-1.5</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>VC</td>
<td>Delay control voltage</td>
<td>-5.0</td>
<td>0</td>
<td>V</td>
</tr>
<tr>
<td>TA</td>
<td>Operating temperature range – die</td>
<td>-15</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage temperature</td>
<td>-65</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters/conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>Operating temperature range – die</td>
<td>0</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>VEE</td>
<td>Power supply voltage</td>
<td>-5</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VC</td>
<td>Delay control voltage</td>
<td>-3.0</td>
<td>-2.6</td>
<td>-2.2</td>
<td>V</td>
</tr>
<tr>
<td>VIL</td>
<td>Input voltage level, low level</td>
<td>0.0</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VIL</td>
<td>Input voltage level, low level</td>
<td>-0.9</td>
<td>-0.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VINDC</td>
<td>DC input voltage (with DC-coupled input)</td>
<td>5</td>
<td></td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Characteristics

1. Electrical characteristics at ambient temperature.
2. In case of single-ended input, the unused pad must be tied to VINDC.
3. In case of single-ended output, the unused pad must be terminated with 50 ohms to ground.
4. Refer to timing diagram.
5. On a 10.7 Gb/s PRBS pattern.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEE</td>
<td>Power supply voltage</td>
<td>-4.5</td>
<td>-5.00</td>
<td>-5.25</td>
<td>V</td>
</tr>
<tr>
<td>VIH</td>
<td>Input voltage level, high level (single ended)</td>
<td>0.0</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VIL</td>
<td>Input voltage level, low level (single ended)</td>
<td>-0.9</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VINDC</td>
<td>DC input voltage (with DC-coupled input) (2)</td>
<td>-0.45</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VOUT</td>
<td>Data output voltage amplitude (3)</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>V</td>
</tr>
<tr>
<td>TR</td>
<td>Output rise time (20% – 80%)</td>
<td>25</td>
<td></td>
<td>ps</td>
<td></td>
</tr>
<tr>
<td>TF</td>
<td>Output fall time (20% – 80%)</td>
<td>23</td>
<td></td>
<td>ps</td>
<td></td>
</tr>
<tr>
<td>TDH</td>
<td>Output delay low-high transition (4)</td>
<td>300</td>
<td></td>
<td>ps</td>
<td></td>
</tr>
<tr>
<td>TDL</td>
<td>Output delay high-low transition (4)</td>
<td>300</td>
<td></td>
<td>ps</td>
<td></td>
</tr>
</tbody>
</table>

Specifications are based on most current or latest revision.

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Electrical Characteristics (cont.)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{ADJ}$</td>
<td>Output phase delay adjustment$^{(4)}$</td>
<td>100</td>
<td>ps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_{11}$</td>
<td>Input return loss (up to 15 GHz)</td>
<td>24</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_{22}$</td>
<td>Output return loss (up to 15 GHz)</td>
<td>3.4</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_{MAX}$</td>
<td>Maximum clock frequency</td>
<td>10.7</td>
<td>GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$J_{p-p}$</td>
<td>Peak-to-peak jitter$^{(5)}$</td>
<td>9</td>
<td>ps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$J_{rms}$</td>
<td>RMS jitter$^{(5)}$</td>
<td>1.5</td>
<td>ps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{EE}$</td>
<td>Power supply current</td>
<td>330</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power dissipation</td>
<td>1.65</td>
<td>W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Evaluation board measurement
Vee: -5.0 V
Input data rate: 10.7 Gb/s
Single-ended data input: +/-450 mVpp
Control voltage: $VC_p = VC_{ref}$, $VC_m = -2.2$ V

Evaluation board measurement
Vee: -5.0 V
Input data rate: 12.5 Gb/s
Single-ended data input: +/-450 mVpp
Control voltage: $VC_p = VC_{ref}$, $VC_m = -3.0$ V
Eye Diagram Performance (cont.)

Evaluation board measurement
Vee: -5.0 V
Input data rate: 12.5 Gb/s
Single-ended data input: +/-450 mVpp
Control voltage: VCp = VRef, VCm = -2.2 to -3.0 V (accumulating)

Evaluation board measurement
Vee: -5.0 V
Input CLK frequency: 12.5 GHz
Single-ended CLK input: +/-450 mVpp
Control voltage: VCp = VRef, VCm = -2.2 V

Recommended Operational Setup

Specifications are based on most current or latest revision.

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Package Drawing and Pinouts

Pinouts:
P1: Vee  P11: Vee
P2: Din  P12: Dout
P3: N/C  P13: N/C
P4: Din/ P14: Dout/
P5: Vee   P15: Vee
P6: N/C  P16: Vee
P7: VCm  P17: N/C
P8: VCp P18: N/C
P9: Vcref P19: N/C
P10: Vee  P20: N/C

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Apply –5V at Vee, Iee=330mA approx.
Apply –2.2V at Vcm (control range from –2.2 to –3.0V)

<table>
<thead>
<tr>
<th></th>
<th>Vee</th>
<th>Iee</th>
<th>Vcm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias</td>
<td>–5</td>
<td>330</td>
<td>–2.2 : –3.0</td>
</tr>
</tbody>
</table>
CAUTION: THIS IS AN ESD SENSITIVE DEVICE

Chip carrier material should be selected to have GaAs compatible thermal coefficient of expansion and high thermal conductivity such as copper molybdenum or copper tungsten. The chip carrier should be machined, finished flat, plated with gold over nickel and should be capable of withstanding 325°C for 15 minutes.

Die attachment for power devices should utilize Gold/Tin (80/20) eutectic alloy solder and should avoid hydrogen environment for HBT devices. Note that the backside of the chip is gold plated and it is connected to RF and DC Ground.

These GaAs devices should be handled with care and stored in dry nitrogen environment to prevent contamination of bonding surfaces. These are ESD sensitive devices and should be handled with appropriate precaution including the use of wrist-grounding straps. All die attach and wire/ribbon bond equipment must be well grounded to prevent static discharges through the device.

Recommended wire bonding: for Signal input / output connections, use either 3 mils wide and 0.5 mil thick gold ribbon or a pair of 1mil diameter wires with lengths as short as practical allowing for appropriate stress relief (typically 400 +/- 100 um long). For all other connections, a single 1 mil dia wire of appropriate minimum length may be used.

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**Datasheet Identification** | **Product Status** | **Definition**
--- | --- | ---
Advanced Information | Formative or or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.

Preliminary | First Production | This datasheet contains preliminary data, and supplementary data will be published at a later date. DIGIMIMIC reserves the right to make changes at any time without notice in order to improve design.

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