

## General Description

The GD19903 is a high-speed amplifier, which provides a high power output drive suitable to feed an optical modulator at 10 Gbit/s.

GD19903 provides single-ended or differential output drive to an external modulator. The outputs must be externally AC coupled, and on-chip termination is provided to minimize reflections.

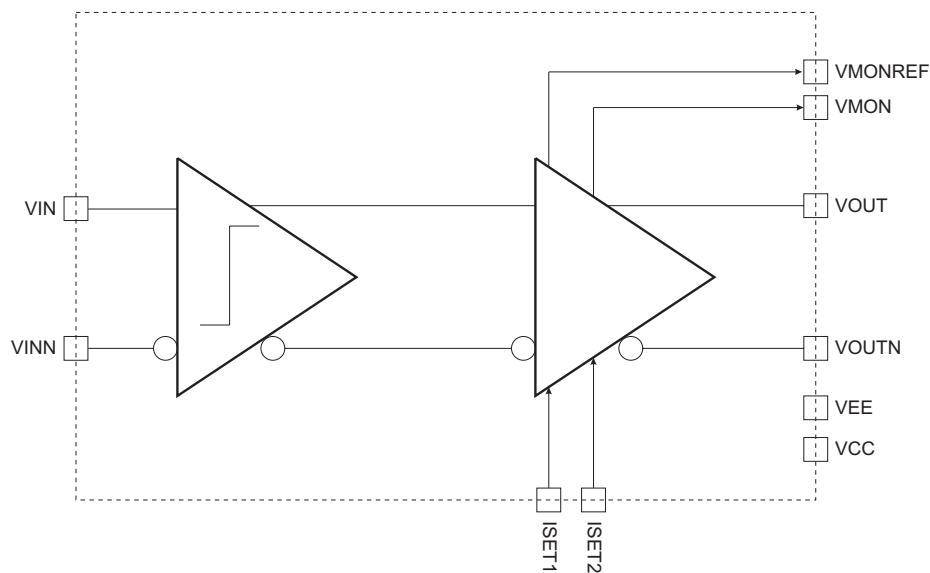
The output amplitude can be adjusted to the required value by sourcing a DC current into a control terminal of the device.

The data outputs can be shut down by setting the amplitude control currents to 0. When shut down, the residual output data amplitude will be less than 1.5 % of maximum amplitude.

The GD19903 modulator driver provides *Amplitude Modulation* (AM) control of the outputs of the modulator driver for control of the modulation in Mach-Zehnder modulators. The AM will be controlled by inserting a dither current at up to 10 kHz with AM amplitude of up to 10 % of the data amplitude.

An analogue monitor output is provided to indicate peak-peak output voltage swing.

The GD19903 modulator driver is delivered in a 68 pin ceramic package. 50  $\Omega$  transmission lines inside the package are ensured by GIGA proprietary Flexguide® technology.



## Advance Information

### Features

- Fully differential, 10 V<sub>PP</sub> differential drive capability.
- CML inputs.
- Limiting structure.
- Output peak-peak monitor.
- Data outputs can be turned off.
- Capability to AM modulate output.
- Power supply: -8.0 V and +5 V
- No external choke required.
- Maximum rise/fall time of 45 ps (20 – 80 %).
- Power dissipation: 8.6 W (typical) at maximum output swing.
- Package: 68 pin MLC

### Applications

- Telecommunications transmission systems:
  - SDH STM-64
  - SONET OC-192
- WDM applications.
- 10 Gbit/s optical transmission.

## Functional Details

### General

The GD19903 modulator driver incorporates a limiting amplifier and provides a high power output.

The device performs the following functions:

1. High output drive capability, sufficient to drive optical III-V modulator or an LiNbO<sub>3</sub> at 9.952 Gbit/s data rate.
2. On chip termination (50  $\Omega$  to ground) on the differential CML inputs. Outputs must be externally AC coupled and on-chip termination is provided to minimize reflections.
3. The output amplitude can be adjusted between maximum and minimum values over a wide temperature and operating range. The amplitude can be controlled by a DC current.
4. Shutdown of output data takes place when the amplitude control current and AM control current are set to 0. The residual output data amplitude rms is within 1.5% of full amplitude.

## Functionality

The GD19903 can be driven with a single ended or a differential input. The unused input does not need to be terminated, but a 50  $\Omega$  resistor AC coupled to GND is recommended. The inputs can be DC coupled, but then the applied circuit must not alter the quiescent input voltage. The DC level at the output vary with the output voltage swing and therefore AC coupling is recommended. When used to drive a single ended load, the unused output shall be 50  $\Omega$  terminated via an AC coupling capacitor. (See Figure 1)

The amplifier output voltage swing is controlled through the current flowing into the pins ISET1 and ISET2. It is recommended that the two pins are tied together giving a common impedance of typical 45  $\Omega$ . Figure 3 shows a typical measurement of VOUT vs. ISET = ISET1 + ISET2. The slope is 0.12 V/mA.

If the two ISET pins are both left open and the Vset pin is connected to GND maximum output voltage swing is achieved. This setting is only recommended for test purposes and VSET input shall normally be left open with a capacitor to GND. Shutting the outputs off can be obtained by tying both ISET1 and ISET2 to VEE.

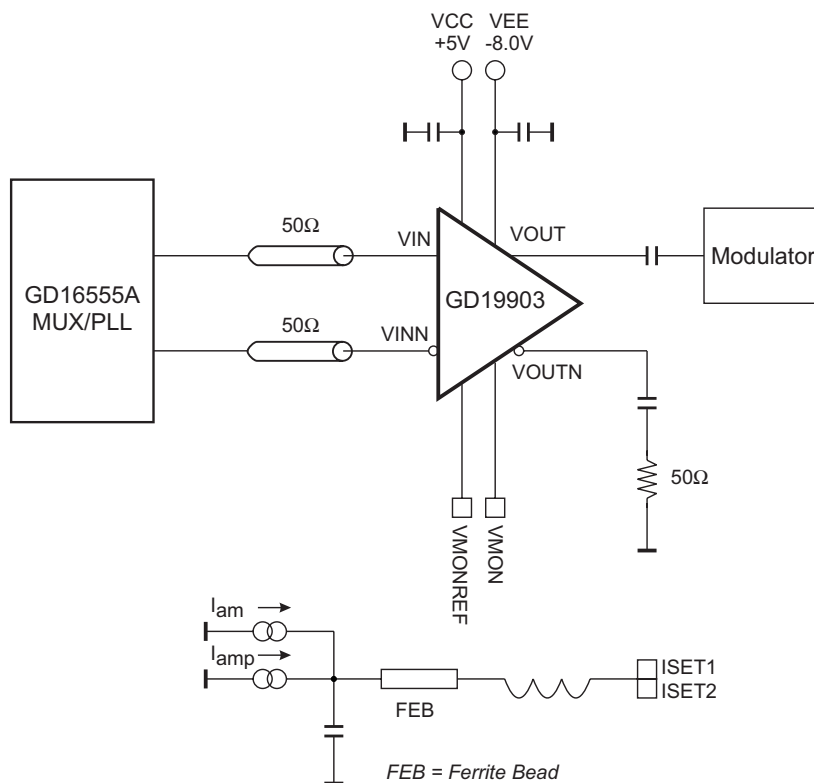


Figure 1. Application Diagram

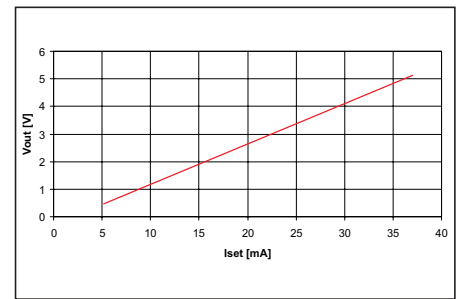


Figure 2. VOUT vs. ISET (Typical).

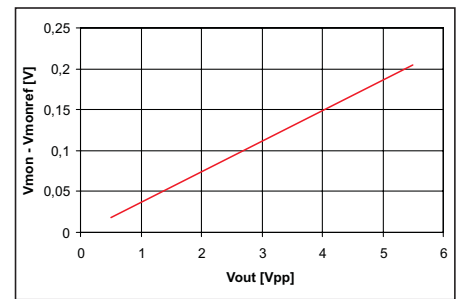


Figure 3. VMON - VMONREF vs. VOUT (Typical).

The voltage difference between Vmon and Vmonref is a measure of the driver output level with a slope of 37 mV/V. Please observe that this relation is only valid with input signals levels within the specified range. Figure 2 shows a typical measurement of VMON – VMONREF vs. VOUT

## Special Precautions

When the GD19903 is used to drive a single-ended load, the unused output shall be terminated (AC coupled) to 50  $\Omega$ .

Inputs VIN/VINN are open circuit and short circuit (to ground) protected.

Outputs VOUT/VOUTN are open circuit protected only. AC short circuit is allowed.

**Note:** DC short circuit to ground will cause permanent damage to the device.

## Pin List

| Mnemonic:    | Pin No.:                                                                                                                                    | Pin Type: | Description:                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------|
| VIN, VINN    | 27, 25                                                                                                                                      | CML       | Data input, differential 10 Gbit/s, DC-coupled.  |
| VOUT, VOUTN  | 61, 59                                                                                                                                      | AC        | Data output, differential 10 Gbit/s, DC-coupled. |
| VMONREF      | 40                                                                                                                                          | DC        | Modulation current monitor reference.            |
| VMON         | 42                                                                                                                                          | DC        | Modulation current monitor.                      |
| ISET1, ISET2 | 41, 13                                                                                                                                      | DC        | Current input for output AGC and AM control.     |
| GND          | 1, 4, 9, 14, 17, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30, 31, 32, 33, 38, 43, 48, 51, 53, 54, 55, 56, 57, 58, 60, 62, 63, 64, 65, 66, 67, 68 | PWR       | Ground, 0V.                                      |
| VEE          | 18, 35                                                                                                                                      | PWR       | -8.0 V negative supply voltage.                  |
| VCC          | 34, 52                                                                                                                                      | PWR       | +5 V positive supply voltage.                    |
| NC           | 2, 3, 5, 6, 7, 8, 10, 11, 12, 15, 16, 36, 37, 39, 44, 45, 46, 47, 49, 50                                                                    |           | Not Connected                                    |

## Package Pinout

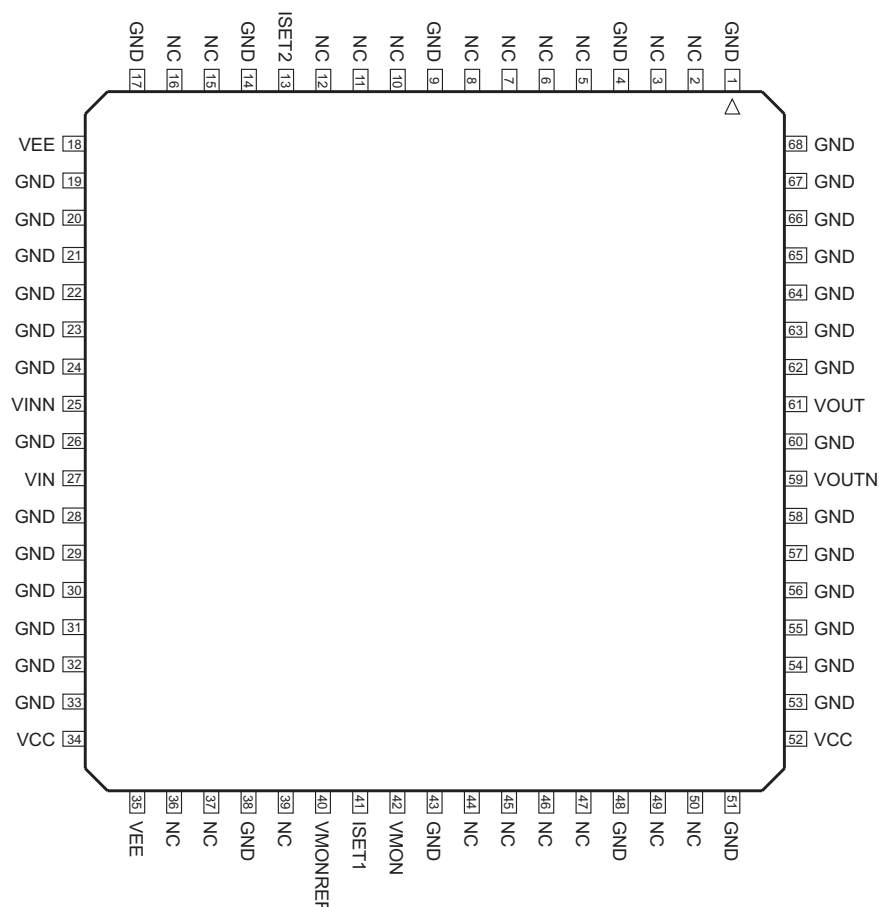


Figure 4. Package 68 pin CML, Top View

## Maximum Ratings

These are the limits beyond which the component may be damaged.

All voltages in the table are referred to GND.

All currents in the table are defined positive out of the pin.

| Symbol:                | Characteristic:                   | Conditions: | MIN.:    | TYP.: | MAX.:        | UNIT: |
|------------------------|-----------------------------------|-------------|----------|-------|--------------|-------|
| $V_{CC}$               | Positive Supply                   |             | GND      |       | 5.5          | V     |
| $V_{EE}$               | Negative Supply                   |             | -8.5     |       | GND          | V     |
| $V_I, V_{IN}, V_{INN}$ | CML Input Voltage                 |             | -3.5     |       | 0.5          | V     |
| $V_{VSET}$             | VSET Voltage Level                |             | $V_{EE}$ |       | GND          | V     |
| $V_{ISET}$             | Voltage @ ISET pin                | Note 1      | $V_{EE}$ |       | $V_{EE} + 4$ | V     |
| $I_{ISET}$             | Amplitude Control Current Level   |             | 0        |       | -45          | mA    |
| $T_0$                  | Operating Temperature, $T_{CASE}$ | Note 2      | 0        |       | 70           | °C    |
| $T_S$                  | Storage Temperature               |             | -65      |       | 125          | °C    |

**Note 1:**  $I_{SET}$  pins are intended for current drive only. Voltage forcing into  $I_{SET}$  pins that exceeds maximum ratings will cause permanent damage to the device.  $I_{SET} = I_{SET1} + I_{SET2}$

**Note 2:** Hot-spot temperature 150 °C @ 70 °C  $T_{CASE}$ .

## DC Characteristics

$T_{CASE} = 0\text{ °C to }70\text{ °C}$ ,  $V_{CC} = +5.0\text{ V } \pm 5\%$ ,  $V_{EE} = -8.0\text{ V } \pm 5\%$ .

All voltages in the table are referenced to GND.

All input signal and power currents in the table are defined positive into the pin.

All output signal currents are defined positive out of the pin.

| Symbol:    | Characteristic:         | Conditions: | MIN.: | TYP.: | MAX.: | UNIT: |
|------------|-------------------------|-------------|-------|-------|-------|-------|
| $V_{CC}$   | Positive Supply         |             | 4.75  | 5     | 5.25  | V     |
| $V_{EE}$   | Negative Supply         |             | -8.4  | -8.0  | -7.6  | V     |
| $I_{CC}$   | Positive Supply Current |             |       |       | 240   | mA    |
| $I_{EE}$   | Negative Supply Current |             |       |       | -1020 | mA    |
| $P_{diss}$ | Power Dissipation       |             |       | 8.6   | 9.7   | W     |

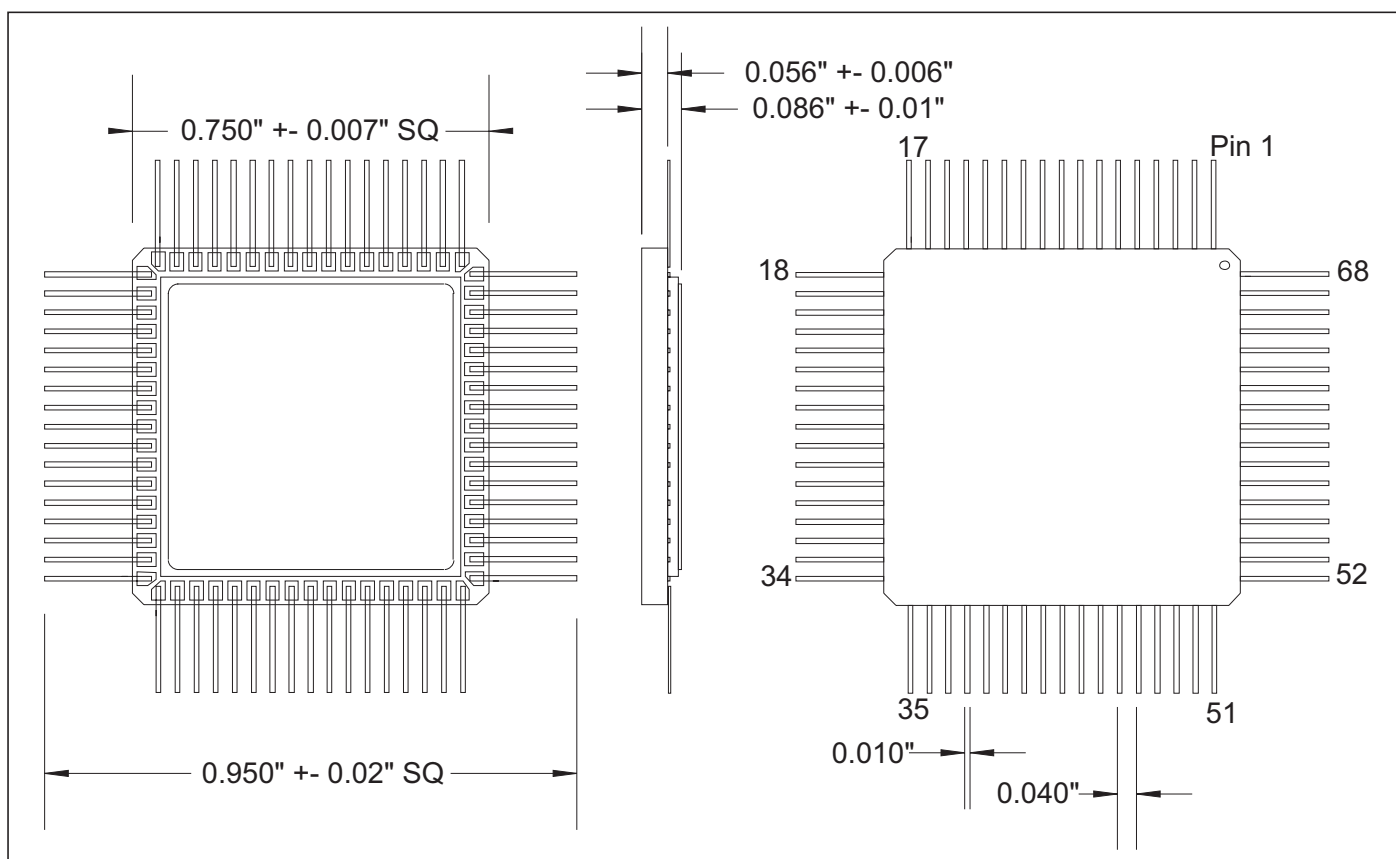
## AC Characteristics

$T_{CASE} = 0\text{ }^{\circ}\text{C}$  to  $70\text{ }^{\circ}\text{C}$ ,  $V_{CC} = +5.0\text{ V} \pm 5\%$ ,  $V_{EE} = -8.0\text{ V} \pm 5\%$ .

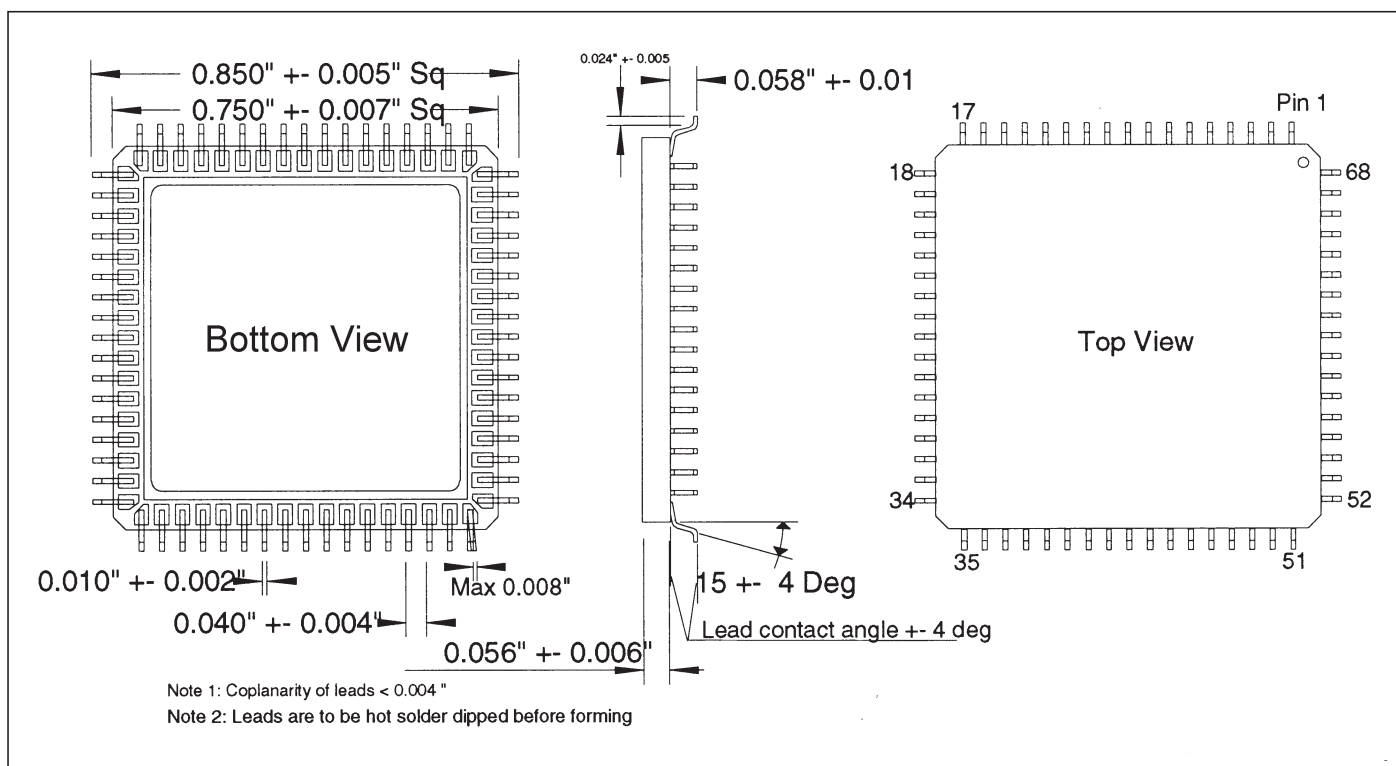
| Symbol:                  | Characteristic:                                    | Conditions:             | MIN.: | TYP.:    | MAX.: | UNIT:     |
|--------------------------|----------------------------------------------------|-------------------------|-------|----------|-------|-----------|
| $V_{VOUT,VOUTN}$         | Output Data Amplitude per Output                   |                         |       | 5.0      |       | $V_{PP}$  |
| $V_{VIN,VINN}$           | Input Data Amplitude per Input                     |                         | 300   | 400      | 500   | $mV_{PP}$ |
| $t_{RISE}/t_{FALL\ IN}$  | Input Data Rise/Fall Time, 20 – 80 %               |                         |       |          | 40    | ps        |
| $t_{RISE}/t_{FALL\ OUT}$ | Output Data Rise/Fall Time, differential 20 – 80 % | $t_{RISE}/t_{FALL\ IN}$ |       | 45       |       | ps        |
| S11                      | 0 - 6 GHz<br>6 - 10 GHz                            | Note 1                  |       | -7<br>-5 |       | dB<br>dB  |
| S22                      | 0 - 6 GHz<br>6 - 10 GHz                            | Note 1                  |       | -7<br>-5 |       | dB<br>dB  |

**Note 1:** Measured on GD19903-68BA (gullwings) on FR4 PCB, GD99903.

## Package Outline



**Figure 5.** Package 68 pin MLC Straight Leads (68AB). All Dimensions are in inch.



**Figure 6.** Package 68 pin MLC Gullwings Leads (68BA). All Dimensions are in inch.

## Device Marking



Figure 7. Device Marking. Top View.

## Ordering Information

To order, please specify as below:

| Product Name:       | Package Type:                                         | Case Temperature Range: | Options: |
|---------------------|-------------------------------------------------------|-------------------------|----------|
| <b>GD19903-68AB</b> | <b>68 pin Straight Leads,</b><br>Multi Layer Ceramic  | 0..70 °C                |          |
| <b>GD19903-68BA</b> | <b>68 pin Gullwings Leads,</b><br>Multi Layer Ceramic | 0..70 °C                |          |



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