

## 1 FEATURES

- It can be powered by a 3V to 5.5V  $V_{CC}$  supply
- Operates up to 500kbps
- Two Drivers and Two Receivers
- Meets or exceeds the Requirements of TIA/EIA-232-F and ITU V.28 standard
- External Capacitors:  $4 \times 0.1\mu F$
- Serial pins provide enhanced ESD protection
- Bus I/O protection
  - ±8kV IEC 61000-4-2 contact discharge
  - ±15kV IEC 61000-4-4 air-gap discharge
  - ±15kV HBM ESD
- Accept 5V logic input when 3.3V supply

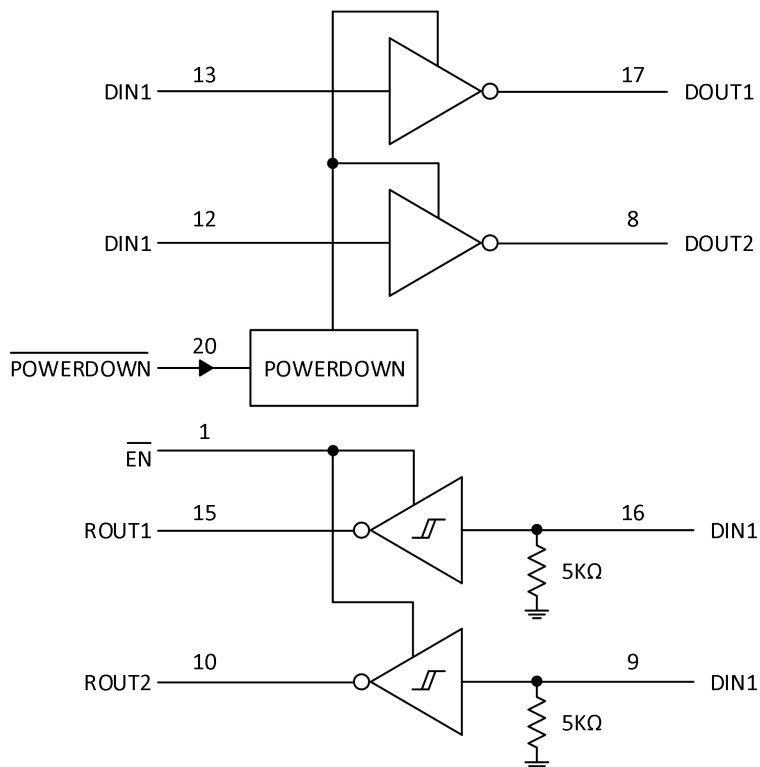
## 2 APPLICATIONS

- Industrial PC
- Wired network
- Data center and enterprise computing
- Notebook, Computers
- Handheld device

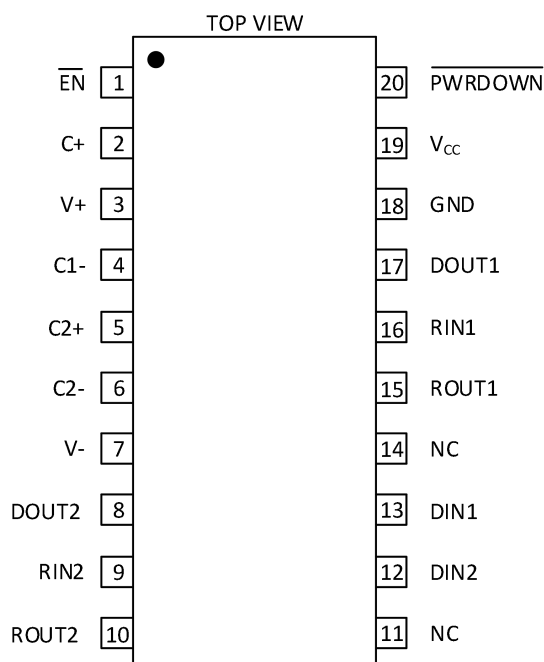
## 3 DESCRIPTION

The GM3222E interface chip consists of two-channel drivers, two-channel receivers, and a dual charge-pump circuit. The serial port has ±15kV IEC ESD protection. The GM3222E meets the requirements of TIA/EIA-232-F and provides the electrical interface function between an asynchronous communication controller and the serial-port connector. The internal charge pump of the chip and four small external capacitors support a single power supply of 3V to 5.5V. The GM3222E supports a data signaling rate of up to 500kbit/s. It can enter shutdown mode which only 1uA by input PWRODMN low.

## FUNCTION BLOCK



## 4 Pin Configuration and Functions



| NAME                        | PIN NO. | DESCRIPTION                 |
|-----------------------------|---------|-----------------------------|
| C1+                         | 2       | Charge pump capacitor pin   |
| C1-                         | 4       | Charge pump capacitor pin   |
| C2+                         | 5       | Charge pump capacitor pin   |
| C2-                         | 6       | Charge pump capacitor pin   |
| DIN1                        | 13      | Driver logic input          |
| DIN2                        | 12      | Driver logic input          |
| DOUT1                       | 17      | RS-232 driver output        |
| DOUT2                       | 8       | RS-232 driver output        |
| $\overline{\text{EN}}$      | 1       | Receiver enable, active low |
| GND                         | 18      | Ground                      |
| NC                          | 11, 14  | No internal connection      |
| $\overline{\text{PWRDOWN}}$ | 20      | Driver disable, active low  |
| RIN1                        | 16      | RS-232 receiver input       |
| RIN2                        | 9       | RS-232 receiver input       |
| ROUT1                       | 15      | Receiver logic output       |
| ROUT2                       | 10      | Receiver logic output       |
| V <sub>CC</sub>             | 19      | Power Supply                |
| V+                          | 3       | Charge pump capacitor pin   |
| V-                          | 7       | Charge pump capacitor pin   |

## 5 Specifications

### 5.1 Absolute Maximum Ratings<sup>(1)</sup>

| PARAMETER        | PARAMETER                                     |                 | MIN   | MAX                  | UNIT |
|------------------|-----------------------------------------------|-----------------|-------|----------------------|------|
| V <sub>CC</sub>  | Supply Voltage                                |                 | -0.3  | 6                    | V    |
| V+               | Positive Output Supply Voltage <sup>(2)</sup> |                 | -0.3  | 7                    | V    |
| V-               | Negative Output Supply Voltage <sup>(2)</sup> |                 | 0.3   | -7                   | V    |
| V+~V-            | Supply Voltage Difference <sup>(2)</sup>      |                 |       | 13                   | V    |
| V <sub>I</sub>   | Input Voltage                                 | Driver input    | -0.3  | 6                    | V    |
|                  |                                               | Receiver input  | -25   | 25                   | V    |
| V <sub>O</sub>   | Output Voltage                                | Driver output   | -13.2 | 13.2                 | V    |
|                  |                                               | Receiver output | -0.3  | V <sub>CC</sub> +0.3 | V    |
| T <sub>J</sub>   | Operating virtual junction temperature        |                 |       | 150                  | °C   |
| T <sub>stg</sub> | Storage temperature range                     |                 | -65   | 150                  | °C   |

1. Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

2. All voltages are with respect to network GND.

### 5.2 ESD RATINGS

|                    |                         |                                                                      |                                                  | TYP    | UNIT |
|--------------------|-------------------------|----------------------------------------------------------------------|--------------------------------------------------|--------|------|
| V <sub>(ESD)</sub> | Electrostatic Discharge | Human-body model(HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>     | All pins except RIN1, RIN2, DOUT1 and DOUT2 pins | ±3000  | V    |
|                    |                         |                                                                      | RIN1, RIN2, DOUT1 and DOUT2 pins to GND          | ±15000 |      |
|                    |                         | Charged device model(CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | All Pins                                         | ±1500  |      |

1: JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.

2: JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

### 5.3 ESD RATINGS - IEC SPECIFICATIONS

| PARAMETER          | PARAMETER               |                                                | TYP    | UNIT |
|--------------------|-------------------------|------------------------------------------------|--------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | IEC 6100-4-2, Contact Discharge <sup>(1)</sup> | ±8000  | V    |
|                    |                         | IEC 6100-4-2, Air-Gap Discharge <sup>(1)</sup> | ±15000 |      |

1. For PW and DB packages only, a minimum of 1μF capacitor is required between VCC and GND to meet the specified IEC 6100-4-2 rating.

2. For optimized IEC ESD performance for DGS package, the recommendation is to have series resistor (≥ 50Ω), on all logic inputs directly connected to power or ground, to minimize the transient currents going into or out of the logic pins.

### 5.4 Recommended Application Conditions<sup>(2)</sup>

| PARAMETER       | CONDITION                 | MIN                   | TYP | MAX | UNIT |
|-----------------|---------------------------|-----------------------|-----|-----|------|
| Supply Voltage  | V <sub>CC</sub> =3.3V     | 3                     | 3.3 | 3.6 | V    |
|                 | V <sub>CC</sub> =5V       | 4.5                   | 5   | 5.5 | V    |
| V <sub>IH</sub> | Driver Input High Voltage | V <sub>CC</sub> =3.3V |     | 5.5 | V    |
|                 |                           | V <sub>CC</sub> =5V   |     | 5.5 | V    |
| V <sub>IL</sub> | Driver Input Low Voltage  | 0                     |     | 0.8 | V    |
| V <sub>I</sub>  | Receiver Input Voltage    | -25                   |     | 25  | V    |
| T <sub>OP</sub> | Operating Temperature     | -40                   |     | +85 | °C   |

2: C1~C4=0.1μF when V<sub>CC</sub>=3.3V±0.3V; When V<sub>CC</sub>=5V±0.5V, C1=0.047μF, C2~C4=0.33μF.

## 5.5 Thermal Information

| PARAMETER             |                                              | SSOP | TSSOP | UNIT |
|-----------------------|----------------------------------------------|------|-------|------|
| R <sub>OJA</sub>      | Junction-to-ambient thermal resistance       | 91.0 | 94.1  | °C/W |
| R <sub>θJC(top)</sub> | Junction-to-case (top) thermal resistance    | 46.2 | 35.2  | °C/W |
| R <sub>θJB</sub>      | Junction-to-board thermal resistance         | 46.1 | 45.5  | °C/W |
| ψ <sub>JT</sub>       | Junction-to-top characterization parameter   | 12.3 | 3.1   | °C/W |
| ψ <sub>JB</sub>       | Junction-to-board characterization parameter | 45.6 | 45.1  | °C/W |

## 5.6 Electrical Characteristics<sup>(3)</sup>

(unless otherwise noted, C1~C4 = 0.1μF at V<sub>CC</sub> = 3.3V±0.3V; C1 = 0.047μF, C2~C4 = 0.33μF at V<sub>CC</sub> = 5V±0.5V; T<sub>A</sub> = +25°C.)

| SYMBOL                       | PARAMETER                                                                         | CONDITION                                                                         |                                                       | MIN                  | TYP                  | MAX | UNIT |
|------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------|----------------------|----------------------|-----|------|
| DC ELECTRICAL CHARACTERISTIC |                                                                                   |                                                                                   |                                                       |                      |                      |     |      |
| I <sub>CC</sub>              | Supply Current                                                                    | No load, V <sub>CC</sub> = 3.3V or 5V                                             |                                                       |                      | 0.3                  | 1.0 | mA   |
| I <sub>I</sub>               | Input leakage current<br>( $\overline{\text{EN}}$ , $\overline{\text{PWRDOWN}}$ ) |                                                                                   |                                                       |                      | ±0.01                | ±1  | μA   |
| Driver                       |                                                                                   |                                                                                   |                                                       |                      |                      |     |      |
| V <sub>OH</sub>              | High-Level Output Voltage                                                         | DOUT at R <sub>L</sub> = 3kΩ to GND,DIN = GND                                     |                                                       | 5                    | 5.4                  |     | V    |
| V <sub>OL</sub>              | Low-Level Output Voltage                                                          | DOUT at R <sub>L</sub> = 3kΩ to GND,DIN = V <sub>CC</sub>                         |                                                       |                      | -5.4                 | -5  |      |
| I <sub>IH</sub>              | High-Level Input Current                                                          | V <sub>I</sub> = V <sub>CC</sub>                                                  |                                                       |                      | ±0.01                | ±1  | μA   |
| I <sub>IL</sub>              | Low-Level Input Current                                                           | V <sub>I</sub> at GND                                                             |                                                       |                      | ±0.01                | ±1  | μA   |
| I <sub>OS</sub>              | Short-Circuit Output Current                                                      | V <sub>CC</sub> = 3.6V, V <sub>O</sub> = 0V                                       |                                                       |                      | ±30                  | ±60 | mA   |
|                              |                                                                                   | V <sub>CC</sub> = 5.5V, V <sub>O</sub> = 0V                                       |                                                       |                      |                      |     |      |
| r <sub>o</sub>               | Output Resistance                                                                 | V <sub>CC</sub> , V <sub>+</sub> , and V <sub>-</sub> = 0 V, V <sub>O</sub> = ±2V |                                                       | 300                  | 10M                  |     | Ω    |
| I <sub>OZ</sub>              | Output leakage current                                                            | $\overline{\text{PWRDOWN}}$ =<br>GND                                              | V <sub>CC</sub> =3V to<br>3.6V,V <sub>O</sub> =±12V   |                      |                      | ±25 | μA   |
|                              |                                                                                   |                                                                                   | V <sub>CC</sub> =4.5V to<br>5.5V,V <sub>O</sub> =±10V |                      |                      | ±25 | μA   |
| RECEIVER                     |                                                                                   |                                                                                   |                                                       |                      |                      |     |      |
| V <sub>OH</sub>              | High-Level Output Voltage                                                         | I <sub>OH</sub> =-1mA                                                             |                                                       | V <sub>CC</sub> -0.6 | V <sub>CC</sub> -0.1 |     | V    |
| V <sub>OL</sub>              | Low-Level Output Voltage                                                          | I <sub>OL</sub> =1.6mA                                                            |                                                       |                      | 0.1                  | 0.4 | mV   |
| V <sub>IT+</sub>             | Positive-Going Input<br>Threshold Voltage                                         | V <sub>CC</sub> =3.3V                                                             |                                                       |                      | 1.4                  | 2.4 | V    |
|                              |                                                                                   | V <sub>CC</sub> =5V                                                               |                                                       |                      | 1.7                  | 2.4 |      |
| V <sub>IT-</sub>             | Negative-Going Input<br>Threshold Voltage                                         | V <sub>CC</sub> =3.3V                                                             |                                                       | 0.6                  | 1.1                  |     | V    |
|                              |                                                                                   | V <sub>CC</sub> =5V                                                               |                                                       | 0.8                  | 1.3                  |     |      |
| V <sub>hys</sub>             | Input Hysteresis (V <sub>IT+</sub> -V <sub>IT-</sub> )                            |                                                                                   |                                                       |                      | 0.4                  |     | V    |
| I <sub>OZ</sub>              | Output leakage current                                                            | $\overline{\text{EN}}$ =1                                                         |                                                       |                      | ±0.05                | ±10 | μA   |
| r <sub>i</sub>               | Input Resistance                                                                  | V <sub>I</sub> = ±3V to ±25V                                                      |                                                       | 3                    | 6                    | 8   | kΩ   |

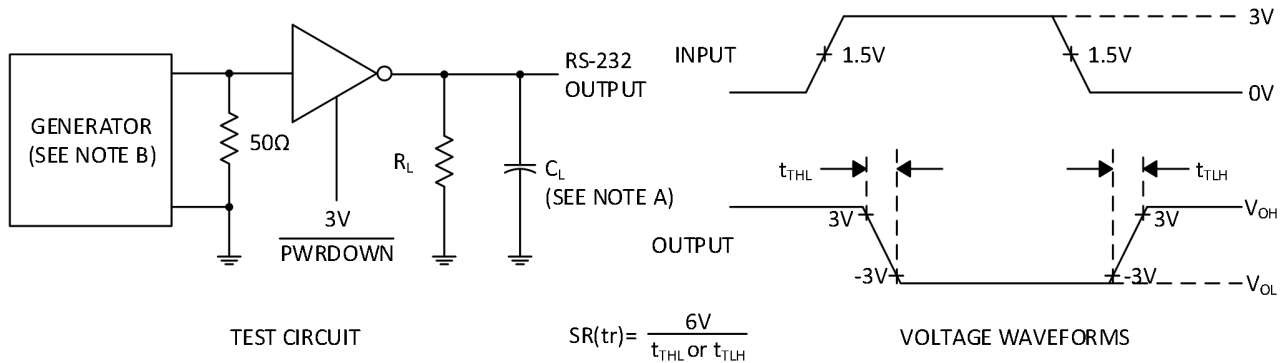
3. Typical Test conditions are at V<sub>CC</sub>=3.3V or V<sub>CC</sub>=5V, T<sub>A</sub>=25°C.

## 5.7 SWITCHING CHARACTERISTICS

(unless otherwise noted, C1~C4 = 0.1μF at V<sub>CC</sub> = 3.3V±0.3V; C1 = 0.047μF, C2~C4 = 0.33μF at V<sub>CC</sub> = 5V±0.5V; T<sub>A</sub> = +25°C.)

| Symbol             | Parameter                           | Condition                                                                                     | MIN    | TYP | MAX      | UNIT |
|--------------------|-------------------------------------|-----------------------------------------------------------------------------------------------|--------|-----|----------|------|
| F <sub>MAX</sub>   | Maximum Data Rate                   | R <sub>L</sub> =3kΩ, C <sub>L</sub> =1000pF, One Dout switching, see <a href="#">Figure 1</a> |        | 500 |          | kbps |
| T <sub>sk(p)</sub> | Pulse skew                          | R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 150pF to 1000pF, see <a href="#">Figure 2</a>   |        | 200 |          | ns   |
| SR <sub>(TR)</sub> | Driver slew rate, transition region | R <sub>L</sub> = 3kΩ to 7kΩ, V <sub>CC</sub> = 3.3V                                           |        |     |          | V/μs |
|                    |                                     | C <sub>L</sub> = 150pF to 1000pF<br>C <sub>L</sub> = 150pF to 2500pF                          | 6<br>4 |     | 30<br>30 |      |

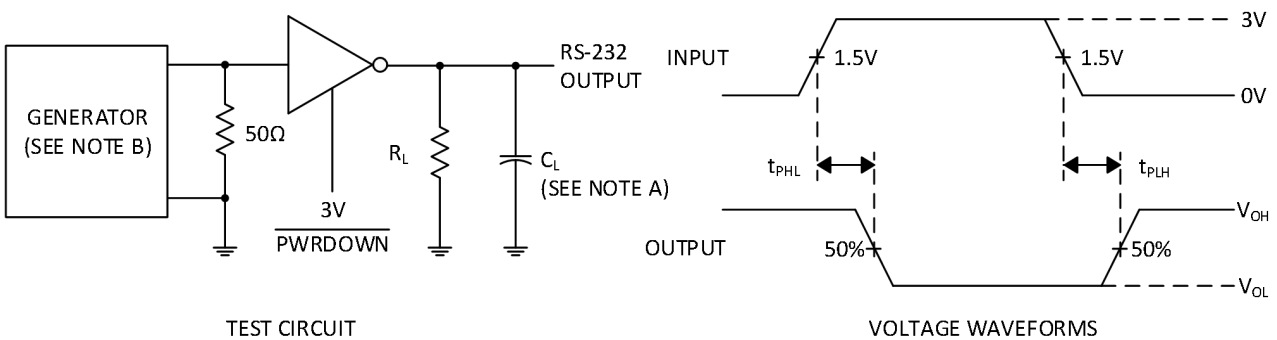
## 6 Parameter Measurement Information



A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250kbit/s,  $Z_0 = 50\Omega$ , 50% duty cycle,  $t_r \leq 10ns$ ,  $t_f \leq 10ns$ .

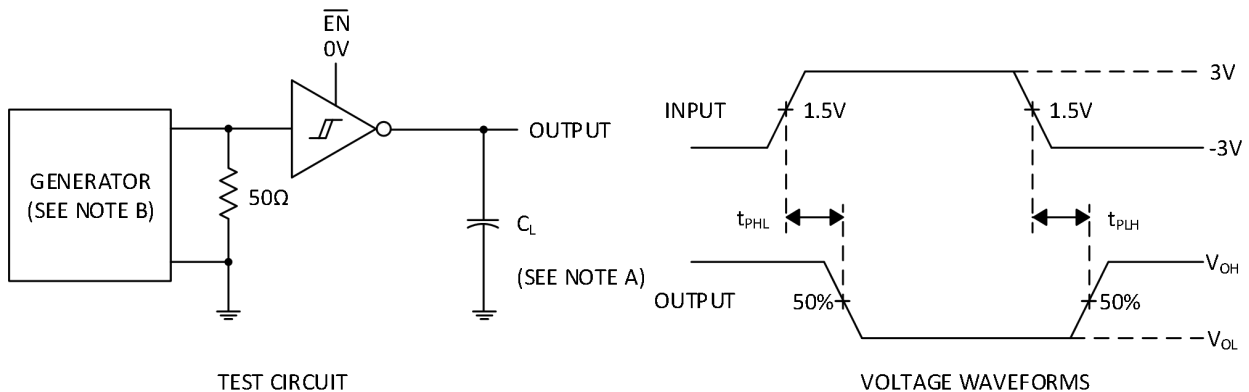
**Figure 1. Driver Skew Rate**



A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250kbit/s,  $Z_0 = 50\Omega$ , 50% duty cycle,  $t_r \leq 10ns$ ,  $t_f \leq 10ns$ .

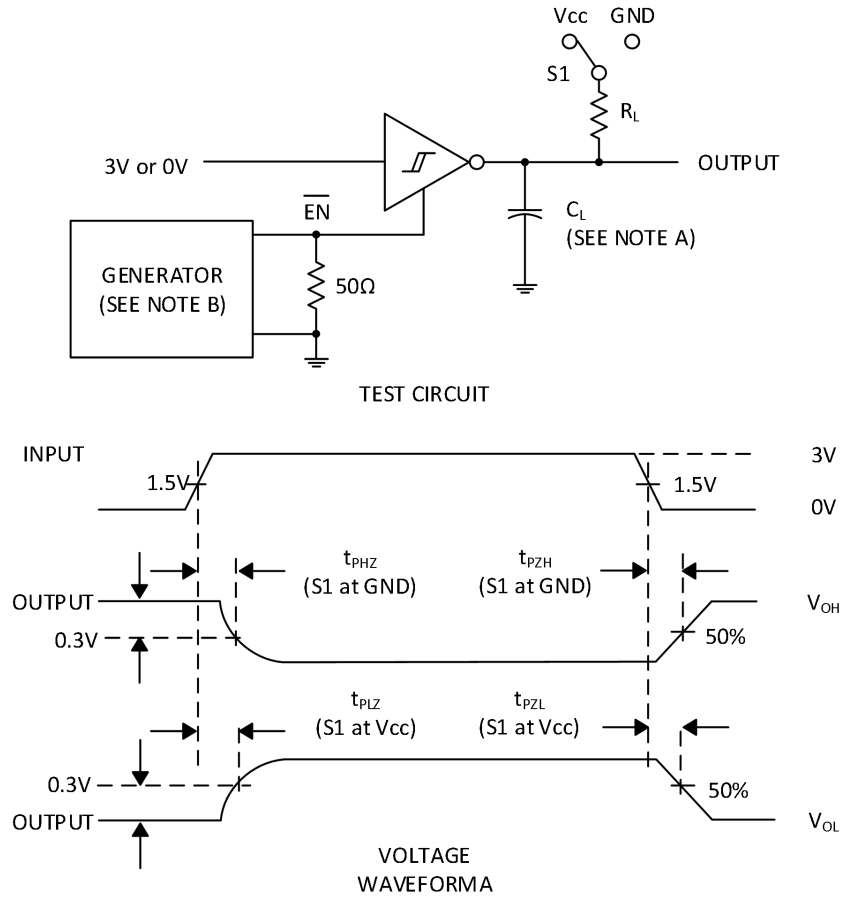
**Figure 2. Driver Pulse Skew**



A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250kbit/s,  $Z_0 = 50\Omega$ , 50% duty cycle,  $t_r \leq 10ns$ ,  $t_f \leq 10ns$ .

**Figure 3. Receiver Propagation Delay Times**



A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250kbit/s,  $Z_O = 50\Omega$ , 50% duty cycle,  $t_r \leq 10\text{ns}$ ,  $t_f \leq 10\text{ns}$ .

**Figure 4. Receiver Enable and Disable Times**

## 7 DETAILED DESCRIPTION

### 7.1 Functional Block Diagram

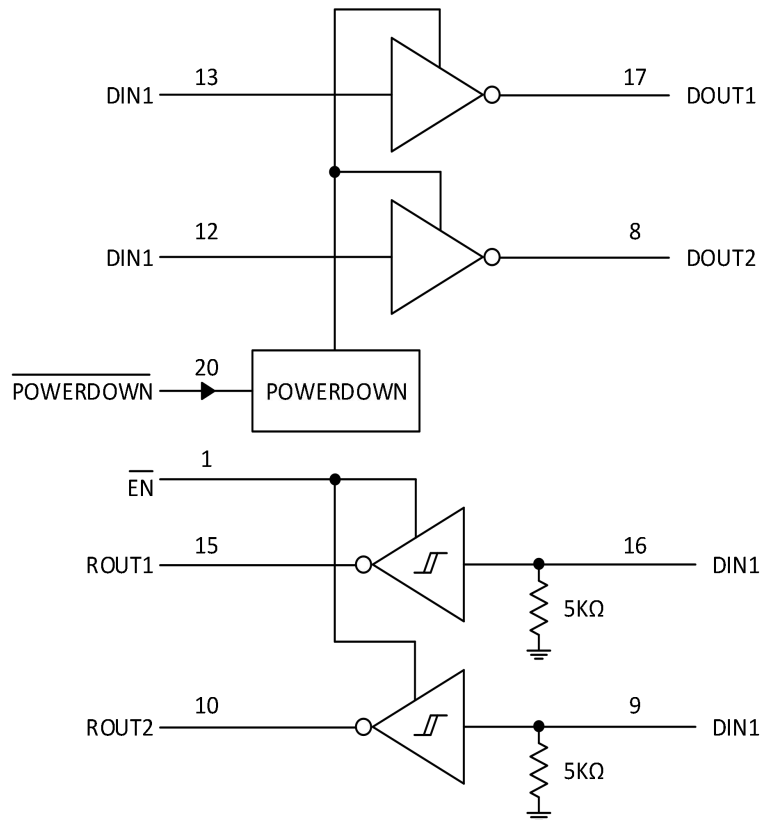


Figure 5. Logic Diagram(Positive Logic)

### 7.2 Device Functional Modes

Table 1.Each Driver

| INPUTS <sup>(1)</sup> |         | OUTPUT |
|-----------------------|---------|--------|
| DIN                   | PWRDOWN | DOUT   |
| X                     | L       | Z      |
| L                     | H       | H      |
| H                     | H       | L      |

Table 2.Each Receiver

| INPUTS <sup>(1)</sup> |    | OUTPUT |
|-----------------------|----|--------|
| RIN                   | EN | ROUT   |
| L                     | L  | H      |
| H                     | L  | L      |
| X                     | H  | Z      |
| OPEN                  | K  | H      |

1. H=high level,L=low level,X=irrelevant,Z=high impedance(off),OPEN=input disconnected or connected driver off.

## 8 APPLICATION AND IMPLEMENTATION

### 8.1 Typical Application

Figure 6 below shows a typical application of GM3222E. The ROUT and DIN pins are connected to the UART port or the common logic line, and the RIN and DOUT pins are connected to the RS232 connector port or the RS232 bus. In order to work properly, please refer to Table 3 to select the appropriate capacitor.

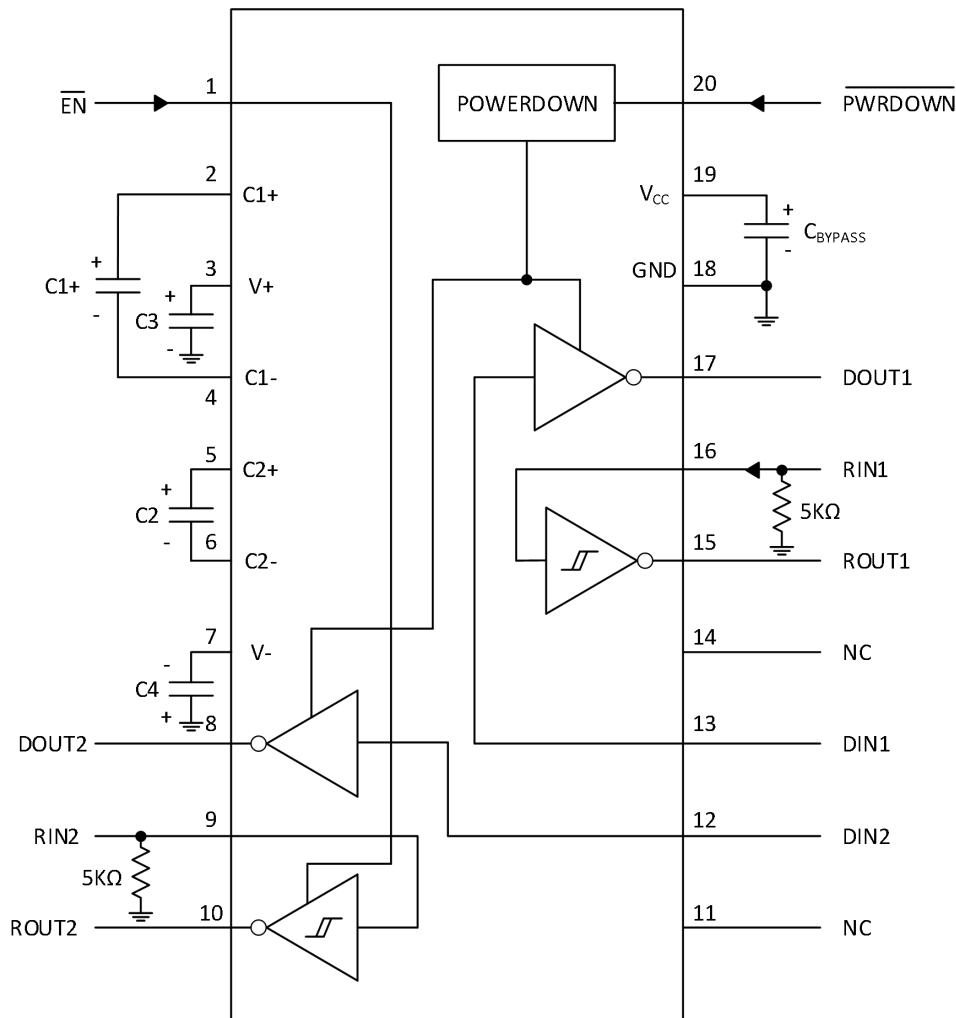


Figure 6. Typical Operating Circuit and Capacitor Values

Notes: C3 can be connected to V<sub>CC</sub> or GND

Table 3. V<sub>CC</sub> vs Capacitor Values

| V <sub>CC</sub> | C1      | C2, C3, C4 |
|-----------------|---------|------------|
| 3.3V±0.3V       | 0.1μF   | 0.1μF      |
| 5V±0.5V         | 0.047μF | 0.33μF     |
| 3V to 5.5V      | 0.1μF   | 0.47μF     |

### 8.2 POWER SUPPLY

The V<sub>CC</sub> voltage must be connected to the same power source used for logic device connected to DIN and ROUT pins. V<sub>CC</sub> must be between 3V and 5.5V.

## 9 LAYOUT

Keep the external capacitor traces short. This is more important on C1 and C2 nodes that have the fastest rise and fall times.

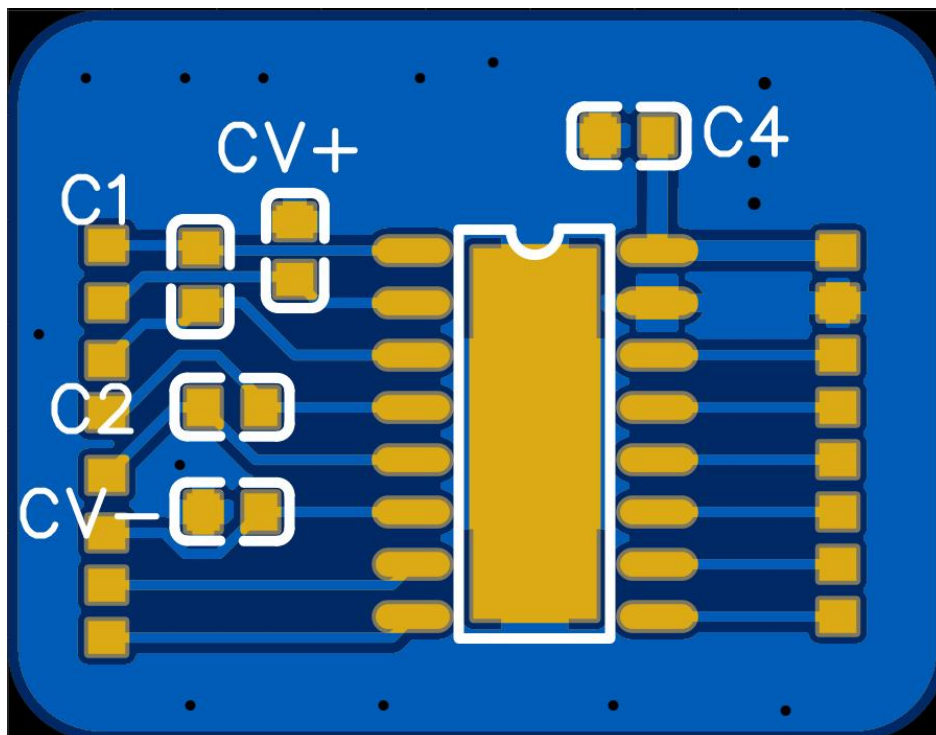
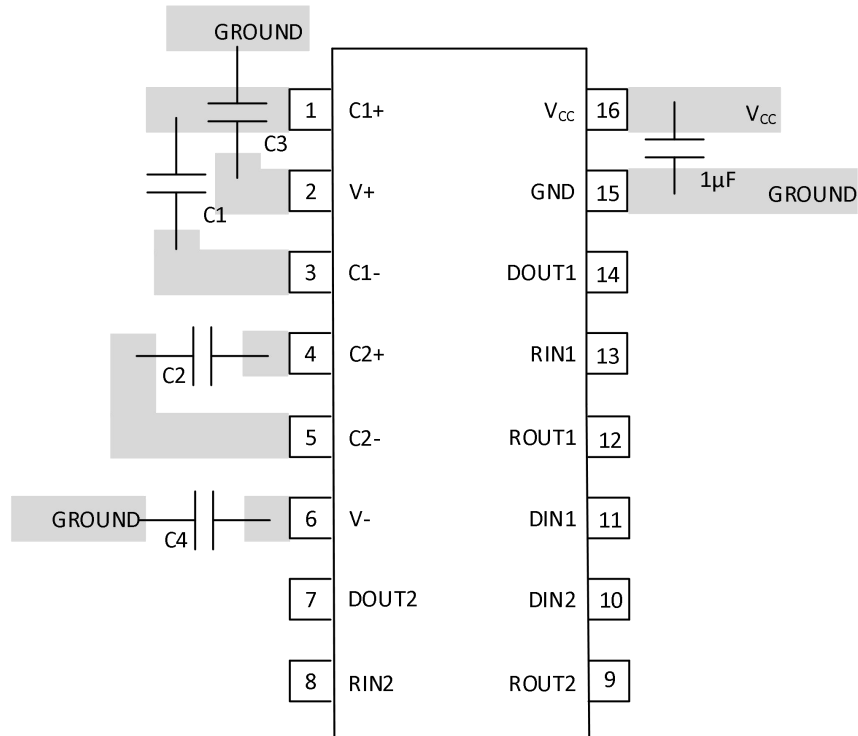
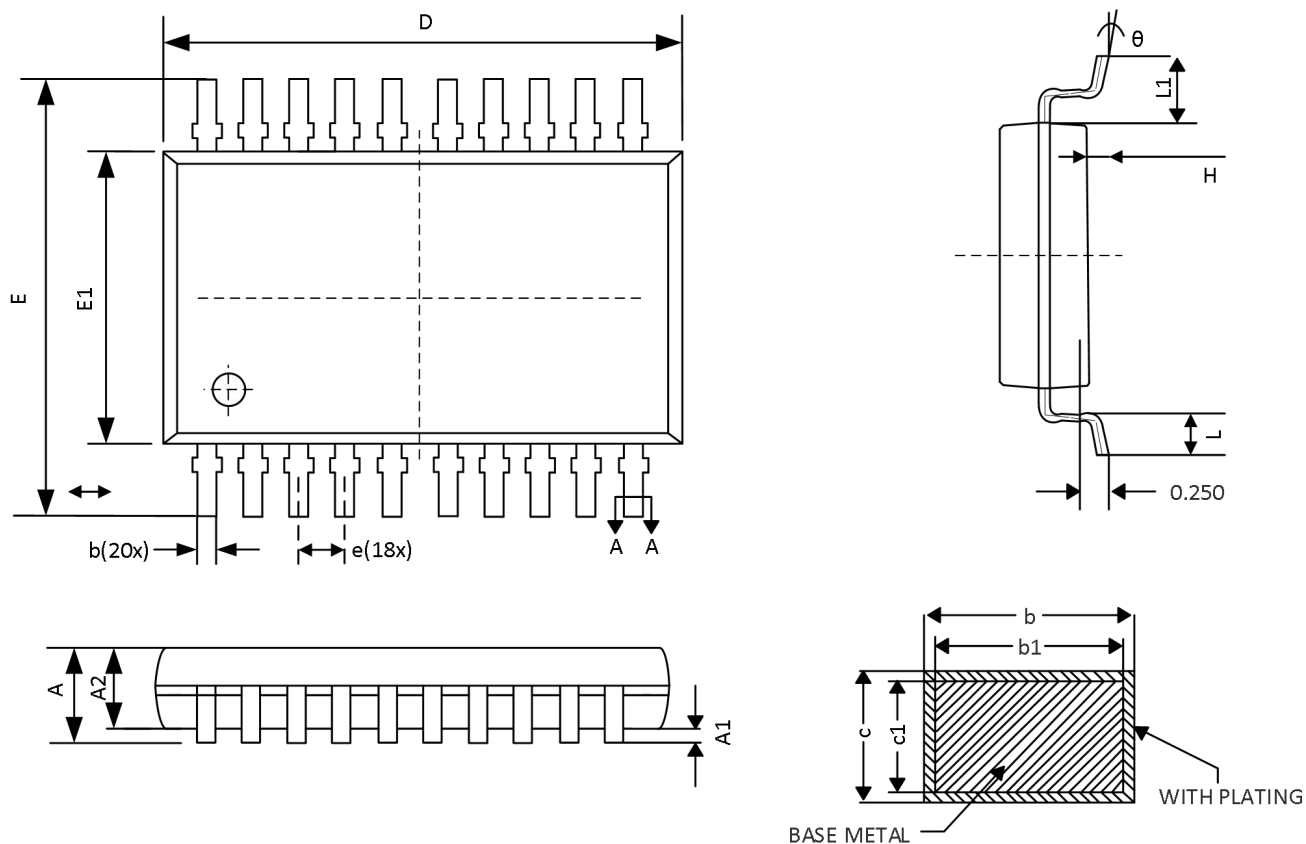


Figure 7. Layout Diagram

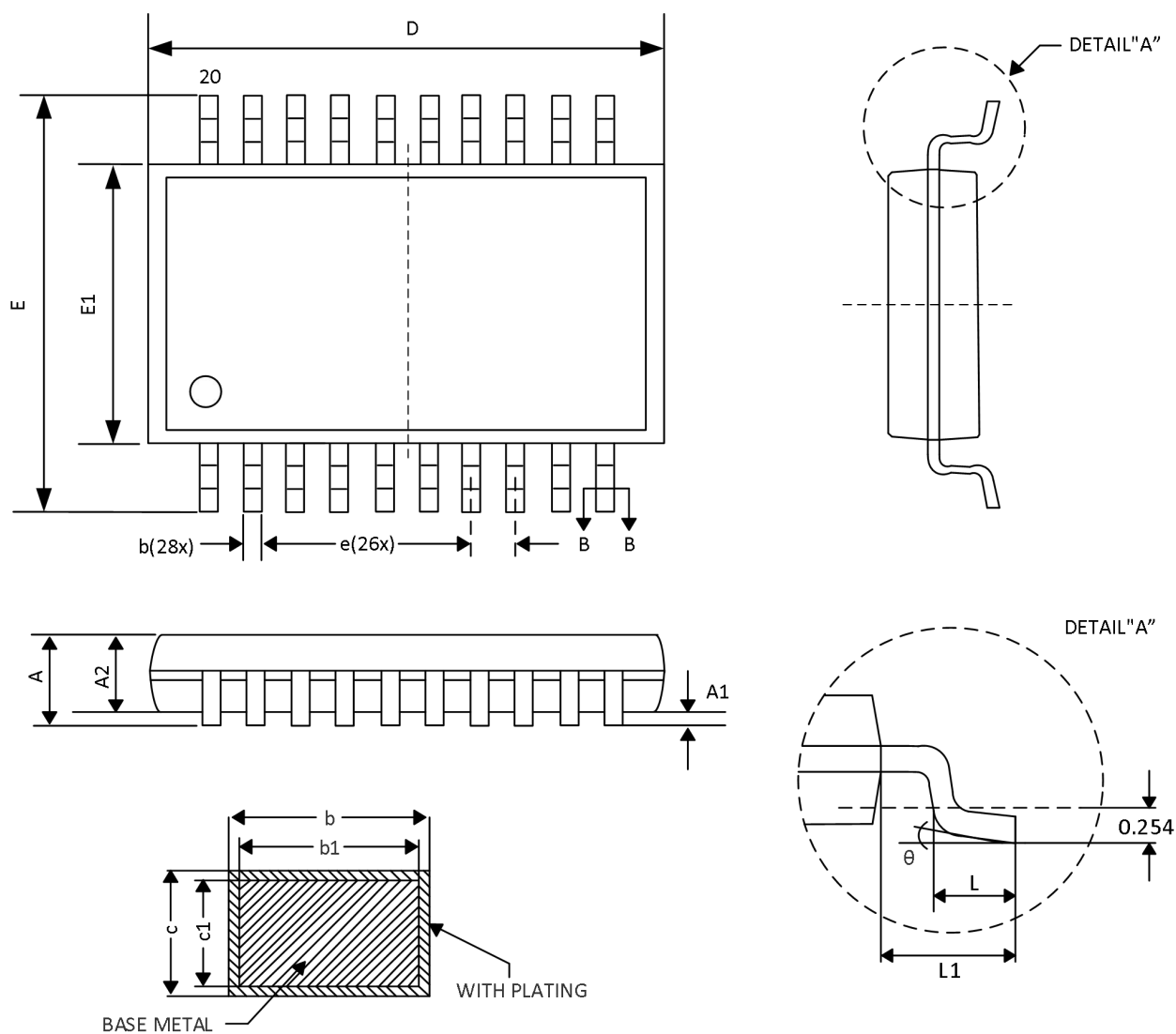
PACKAGE DIMENSION

TSSOP20



|                      | SYMBOL   | MIN     | NOM   | MAX  |
|----------------------|----------|---------|-------|------|
| TOTAL THICKNESS      | A        | -       | -     | 1.20 |
| STAND OFF            | A1       | 0.05    | 0.100 | 0.15 |
| MOLD TOTAL THICKNESS | A2       | 0.90    | 1.00  | 1.05 |
| LEAD WIDTH-1         | b        | 0.20    | -     | 0.28 |
| LEAD WIDTH-2         | b1       | 0.19    | 0.22  | 0.25 |
| LEAD THICKNESS-1     | c        | 0.13    | -     | 0.17 |
| LEAD THICKNESS-2     | C1       | 0.120   | 0.127 | 0.14 |
| MOLD LENGTH          | D        | 6.40    | 6.50  | 6.60 |
| LEAD SPAN            | E        | 6.20    | 6.40  | 6.60 |
| MOLD WIDTH           | E1       | 4.30    | 4.40  | 4.50 |
| LEAD PITCH           | e        | 0.65BSC |       |      |
| LEAD LENGTH          | L1       | 0.85    | 1.00  | 1.15 |
| LEAD SOLE LENGTH     | L        | 0.45    | 0.60  | 0.75 |
| LEAD FORM ANGLE      | $\theta$ | 0°      | -     | 8°   |

SSOP20



| SYMBOL   | DIM | MIN      | NOM | MAX  |
|----------|-----|----------|-----|------|
| A        |     | 1.65     | -   | 1.85 |
| A1       |     | 0.05     | -   | 0.25 |
| A2       |     | 1.45     | -   | 1.55 |
| b        |     | 0.28     | -   | 0.36 |
| B1       |     | 0.30BSC  |     |      |
| c        |     | 0.15     | -   | 0.19 |
| C1       |     | 0.152BSC |     |      |
| D        |     | 7.15     | -   | 7.25 |
| E        |     | 7.65     | -   | 7.95 |
| E1       |     | 5.25     | -   | 5.35 |
| e        |     | 0.65BSC  |     |      |
| L        |     | 0.60     | -   | 0.80 |
| L1       |     | 1.25TYPE |     |      |
| $\theta$ |     | 0°       | -   | 8°   |

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**Order Information**

| Order number | Package | Marking information | Operation Temperature Range | MSL Grade | Ship, Quantity | Green |
|--------------|---------|---------------------|-----------------------------|-----------|----------------|-------|
| GM3222ETA    | TSSOP20 | GM3222ETA           | -40 to 85°C                 | 3         | T&R,2500       | RoHS  |
| GM3222EBA    | SSOP20  | GM3222EBA           | -40 to 85°C                 | 3         | T&R,2500       | RoHS  |