

# Configurable Adaptive Cable Equalizer/Cable Driver

## Gennum Products

### Key Features

- Connection to a single BNC connector as an adaptive cable equalizer or cable driver
- Performance and cable reach optimized for SMPTE ST 424, SMPTE ST 292, and SMPTE ST 259 data rates
- Multi-rate operation from 125Mb/s to 2.97Gb/s in Equalizer Mode and 270Mb/s to 2.97Gb/s in Cable Driver Mode
- Supports DVB-ASI at 270Mb/s
- Integrated 100Ω, differential digital data input/output termination
- Low power operation from a single 3.3V supply:
  - ♦ 206mW typical power consumption in EQ mode
  - ♦ 190mW typical power consumption in CD mode
- Temperature range: -40°C to +85°C
- 32-pin 5mm x 5mm QFN package

### Cable Equalizer Features

- Integrated cable equalizer:
  - ♦ 140m - 3G
  - ♦ 260m - HD
  - ♦ 500m - SD
- Carrier detect with adjustable squelch threshold
- Optional automatic power-down on loss of input signal

### Cable Driver Features

- Selectable output slew rate cable driver for compliance with SMPTE ST 424, SMPTE ST 292, and SMPTE ST 259 standards

### Applications

- SMPTE ST 424, SMPTE ST 292 and SMPTE ST 259 interfaces requiring switching between cable equalizing or cable driving functionality

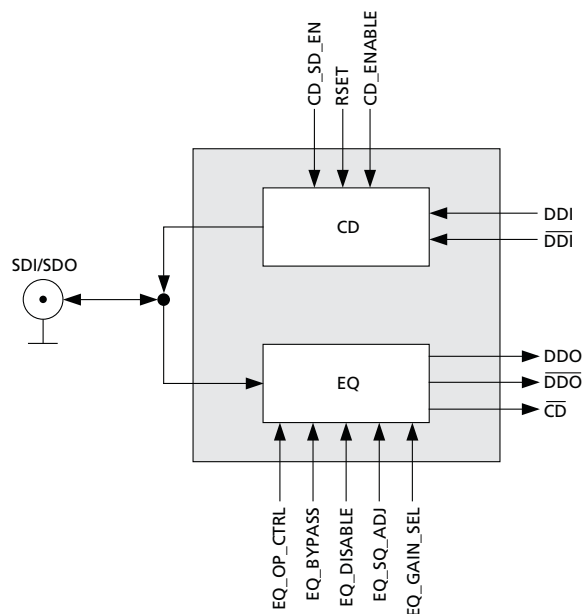
### Description

The GS3490 features integrated adaptive cable equalizer and cable driver functionality. The GS3490 can be field-configured as a SMPTE compliant cable equalizer or a SMPTE compliant cable driver.

The GS3490 is optimized for applications with limited I/O space. With its configurable EQ and cable driver functionality, the GS3490 can be utilized as a single-device solution in applications where the interface connector can be configured as either an input or output.

The GS3490's cable equalizer is optimized for operation at 2.97Gb/s, 1.485Gb/s and 270Mb/s while providing typical cable reach of 140m at 2.97Gb/s, 260m at 1.485Gb/s and 500m at 270Mb/s.

In cable driver mode, the dual slew rate capability provides compatibility to SMPTE ST 424, SMPTE ST 292 and SMPTE ST 259 interfaces.



**GS3490 Block Diagram**

## Revision History

| Version | ECO    | PCN | Date           | Changes and/or Modifications                                               |
|---------|--------|-----|----------------|----------------------------------------------------------------------------|
| 1       | 019093 | —   | April 2014     | Converted to Final Data Sheet. Updated Common Mode Voltage specifications. |
| 0       | 015642 | —   | September 2013 | Updated to Preliminary Data Sheet. Default state of CD_ENABLE corrected.   |
| B       | 011682 | —   | March 2013     | Updates throughout the document.                                           |
| A       | 158716 | —   | October 2012   | New Document.                                                              |

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# 1. Pin Out

## 1.1 Pin Assignment

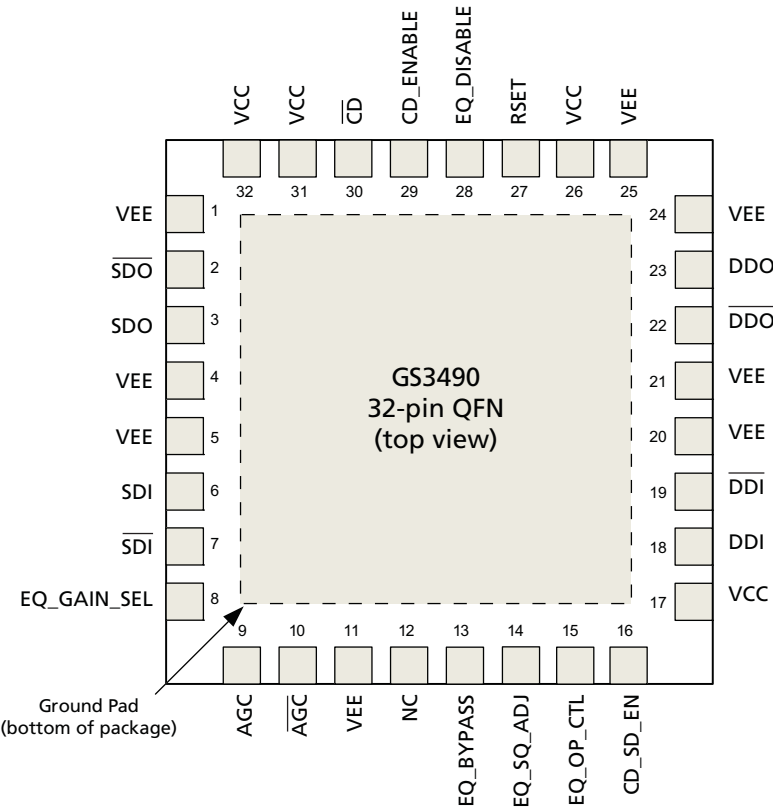


Figure 1-1: Pin Out

## 1.2 Pin Descriptions

Table 1-1: GS3490 Pin Descriptions

| Pin Number                  | Name                         | Type   | Description                                            |
|-----------------------------|------------------------------|--------|--------------------------------------------------------|
| 1, 4, 5, 11, 20, 21, 24, 25 | VEE                          | Power  | Most negative power supply connection. Connect to GND. |
| 2, 3                        | $\overline{\text{SDO}}$ /SDO | Output | Serial data output.                                    |
| 6, 7                        | SDI/ $\overline{\text{SDI}}$ | Input  | Serial data input.                                     |

**Table 1-1: GS3490 Pin Descriptions (Continued)**

| Pin Number     | Name                         | Type   | Description                                                                                                                                                                                                                                                                                                                                                           |
|----------------|------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8              | EQ_GAIN_SEL                  | Input  | Input Sensitivity Control.<br>Please refer to the input logic parameter in <a href="#">Table 2-2: DC Electrical Characteristics</a> for logic level threshold and compatibility. This pin is a 3.3V input.<br>When HIGH, the device compensates for an additional 6dB of loss across the entire operating band.<br>This pin has an internal 100kΩ pull-down resistor. |
| 9, 10          | AGC/ $\overline{\text{AGC}}$ | —      | External AGC capacitor connection.                                                                                                                                                                                                                                                                                                                                    |
| 12             | NC                           | —      | No Connect. Not bonded internally.                                                                                                                                                                                                                                                                                                                                    |
| 13             | EQ_BYPASS                    | Input  | Equalizer Bypass Control.<br>Please refer to the input logic parameter in <a href="#">Table 2-2</a> for Logic Level threshold and compatibility.<br>For details on operation, refer to <a href="#">Section 4.1.3</a> .<br>This pin has an internal 100kΩ pull-down resistor.                                                                                          |
| 14             | EQ_SQ_ADJ                    | Input  | Squelch Threshold Adjust.<br>For details on operation, refer to <a href="#">Section 4.1.5</a> .<br>This pin has an internal 82.4kΩ pull-down resistor.                                                                                                                                                                                                                |
| 15             | EQ_OP_CTL                    | Input  | Controls the Output Swing, De-emphasis and Mute features of the DDO/ $\overline{\text{DDO}}$ outputs.<br>For details on operation, refer to <a href="#">Section 4.1.7</a> .<br>This pin has an internal 1MΩ pull-down resistor.                                                                                                                                       |
| 16             | CD_SD_EN                     | Input  | Cable Driver Slew Rate Control.<br>For details on operation, refer to <a href="#">Section 4.2.4</a> .<br>When left unconnected, the default state of this pin is logic HIGH                                                                                                                                                                                           |
| 17, 26, 31, 32 | VCC                          | Power  | Most positive power supply connection.<br>Connect to 3.3V DC.                                                                                                                                                                                                                                                                                                         |
| 18, 19         | DDI/ $\overline{\text{DDI}}$ | Input  | Differential digital data input to cable driver core.                                                                                                                                                                                                                                                                                                                 |
| 22, 23         | $\overline{\text{DDO}}$ /DDO | Output | Differential digital data output from cable equalizer core.                                                                                                                                                                                                                                                                                                           |
| 27             | RSET                         | —      | External cable driver output amplitude control resistor connection.                                                                                                                                                                                                                                                                                                   |
| 28             | EQ_DISABLE                   | Input  | Equalizer Mode Disable Control.<br>Please refer to the input logic parameter in <a href="#">Table 2-2</a> for logic level threshold and compatibility.<br>For details on operation, refer to <a href="#">Section 4.1.1</a> .<br>This pin has an internal 100kΩ pull-down resistor.                                                                                    |

**Table 1-1: GS3490 Pin Descriptions (Continued)**

| Pin Number | Name                   | Type   | Description                                                                                                                                                                                                                                                                                          |
|------------|------------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29         | CD_ENABLE              | Input  | Cable Driver Mode Enable Control.<br>Please refer to the input logic parameter in <a href="#">Table 2-2</a> for logic level threshold and compatibility.<br>For details on operation, refer to <a href="#">Section 4.2.1</a> .<br>When left unconnected, the default state of this pin is logic LOW. |
| 30         | $\overline{\text{CD}}$ | Output | Equalizer Carrier Detect Status Output.<br>Please refer to the output logic parameter in <a href="#">Table 2-2</a> for logic level threshold and compatibility.<br>For details on operation, refer to <a href="#">Section 4.1.4</a> .                                                                |
| —          | Center Pad             | Power  | Internally bonded to VEE.<br>For more details, refer to <a href="#">Section 6.3</a> .                                                                                                                                                                                                                |

## 2. Electrical Characteristics

### 2.1 Absolute Maximum Ratings

**Table 2-1: Absolute Maximum Ratings**

| Parameter                       | Value                                          |
|---------------------------------|------------------------------------------------|
| Supply Voltage                  | -0.5V to 3.6V <sub>DC</sub>                    |
| Input ESD Voltage (HBM)         | 3kV                                            |
| Storage Temperature Range       | -50°C to 125°C                                 |
| Input Voltage Range (any input) | -0.3 to (V <sub>CC</sub> + 0.3)V <sub>DC</sub> |
| Operating Temperature Range     | -40°C to +85°C                                 |
| Solder Reflow Temperature       | 260°C                                          |

**Note:** Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation outside of the ranges shown in the AC/DC electrical characteristics tables is not guaranteed.

### 2.2 DC Electrical Characteristics

**Table 2-2: DC Electrical Characteristics**

V<sub>CC</sub> = +3.3V ± 5%, T<sub>A</sub> = -20°C to +85°C (unless otherwise shown), Functional Temperature Range: -40°C to +85°C

| Parameter         | Symbol          | Conditions                                                | Min   | Typ | Max   | Units | Notes |
|-------------------|-----------------|-----------------------------------------------------------|-------|-----|-------|-------|-------|
| Supply Voltage    | V <sub>CC</sub> | –                                                         | 3.135 | 3.3 | 3.465 | V     | –     |
| Power Consumption | P <sub>D</sub>  | Equalizer Mode<br>DDO Output Swing = 425mV <sub>ppd</sub> | –     | 206 | 248   | mW    | 4     |
|                   |                 | Equalizer Mode<br>DDO Output Swing = 850mV <sub>ppd</sub> | –     | 244 | 289   | mW    | 4     |
|                   |                 | Cable Driver Mode                                         | –     | 190 | 235   | mW    | 1     |
|                   |                 | Power-Down Mode<br>EQ_DISABLE = 1, CD_ENABLE = 0          | –     | 39  | 56    | mW    | –     |
| Supply Current    | I <sub>S</sub>  | Equalizer Mode<br>DDO Output Swing = 425mV <sub>ppd</sub> | –     | 65  | 77    | mA    | 3     |
|                   |                 | Equalizer Mode<br>DDO Output Swing = 850mV <sub>ppd</sub> | –     | 74  | 87    | mA    | 3     |
|                   |                 | Cable Driver Mode                                         | –     | 58  | 68    | mA    | 1     |
|                   |                 | Power-Down Mode<br>EQ_DISABLE = 1, CD_ENABLE = 0          | –     | 12  | 17    | mA    | –     |

**Table 2-2: DC Electrical Characteristics (Continued)**

$V_{CC} = +3.3V \pm 5\%$ ,  $T_A = -20^{\circ}C$  to  $+85^{\circ}C$  (unless otherwise shown), Functional Temperature Range:  $-40^{\circ}C$  to  $+85^{\circ}C$

| Parameter                                | Symbol                                                                                                   | Conditions                                 | Min                               | Typ                         | Max                                 | Units | Notes |
|------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------|-----------------------------|-------------------------------------|-------|-------|
| $\overline{CD}$ Output Voltage           | $V_{\overline{CD}(OH)}$                                                                                  | Carrier not present                        | 2.0                               | –                           | –                                   | V     | –     |
|                                          | $V_{\overline{CD}(OL)}$                                                                                  | Carrier present                            | –                                 | –                           | 0.4                                 | V     | –     |
| Input Voltage - Digital Pins             | $V_{EQ\_BYPASS},$<br>$V_{EQ\_DISABLE},$<br>$V_{EQ\_GAIN\_SEL},$<br>$V_{CD\_SD\_EN},$<br>$V_{CD\_ENABLE}$ | Minimum to assert and maximum to de-assert | 1.7                               | –                           | 0.4                                 | V     | –     |
| $SDI/\overline{SDI}$ Common Mode Voltage | $V_{CMIN}$                                                                                               | Common Mode                                | 1.62                              | 1.71                        | 1.80                                | V     | –     |
| $DDO/\overline{DDO}$ Common Mode Voltage | $V_{CMDDO}$                                                                                              | Common Mode                                | See <a href="#">Section 4.1.6</a> |                             |                                     | V     | –     |
| $DDI/\overline{DDI}$ Common Mode Voltage | $V_{CMDDI}$                                                                                              | Common Mode<br>AC-coupled                  | $1.4 + \frac{\Delta V_{DDI}}{4}$  | –                           | $V_{CC} - \frac{\Delta V_{DDI}}{4}$ | V     | –     |
| $SDO/\overline{SDO}$ Common Mode Voltage | $V_{CMOUT}$                                                                                              | Common Mode<br>AC-coupled                  | –                                 | $V_{TERM} - \Delta V_{SDO}$ | –                                   | V     | 2     |

**Notes:**

1. Power consumed by GS3490 only. Termination resistors draw extra current.
2. Refer to [4.2.3 Serial Data Outputs \(SDO/SDO\)](#).
3. De-emphasis off. With De-emphasis enabled, add 3mA at typical conditions.
4. De-emphasis off. With De-emphasis enabled, add 10mW at typical conditions.

## 2.3 AC Electrical Characteristics

**Table 2-3: AC Electrical Characteristics - Equalizer Mode**

$V_{CC} = +3.3V \pm 5\%$ ,  $T_A = -20^\circ C$  to  $+85^\circ C$  (unless otherwise shown), Functional Temperature Range:  $-40^\circ C$  to  $+85^\circ C$

| Parameter                                  | Symbol                   | Conditions                                      | Min | Typ | Max  | Units             | Notes |
|--------------------------------------------|--------------------------|-------------------------------------------------|-----|-----|------|-------------------|-------|
| Serial Data Rate                           | $DR_{SDI}$               | –                                               | 125 | –   | 2970 | Mb/s              | 1     |
| SDI/ $\overline{SDI}$ Input Voltage Swing  | $\Delta V_{SDI}$         | 270Mb/s and 1.485Gb/s                           | 720 | 800 | 950  | mV <sub>ppd</sub> | 2     |
|                                            |                          | 2.97Gb/s                                        | 720 | 800 | 880  | mV <sub>ppd</sub> | 2     |
| DDO/ $\overline{DDO}$ Output Voltage Swing | $\Delta V_{DDO}$         | 100 $\Omega$ load, EQ_OP_CTL set for high swing | 700 | 850 | 1000 | mV <sub>ppd</sub> | –     |
|                                            |                          | 100 $\Omega$ load, EQ_OP_CTL set for low swing  | 350 | 425 | 500  | mV <sub>ppd</sub> | –     |
| DDO/ $\overline{DDO}$ Output Jitter        | –                        | 2.97Gb/s Belden 1694A: 0-140m                   | –   | 0.2 | 0.45 | UI                | 3, 4  |
|                                            |                          | 1.485Gb/s Belden 1694A: 0-200m                  | –   | –   | 0.2  | UI                | 3, 4  |
|                                            |                          | 1.485Gb/s Belden 1694A: 200-260m                | –   | 0.3 | 0.4  | UI                | 3, 4  |
|                                            |                          | 270Mb/s Belden 1694A: 0-300m                    | –   | 0.1 | 0.2  | UI                | 3, 4  |
|                                            |                          | 270Mb/s Belden 1694A: 300-500m                  | –   | 0.2 | 0.3  | UI                | 3, 4  |
| DDO/ $\overline{DDO}$ Rise/Fall Time       | $t_r, t_f$               | 1.485Gb/s and 2.97Gb/s, 20% - 80%               | –   | 75  | –    | ps                | –     |
|                                            |                          | 270Mb/s, 20% - 80%                              | –   | 150 | –    | ps                | –     |
| Mismatch in Rise/Fall Time                 | $\Delta t_r, \Delta t_f$ | –                                               | –   | –   | 30   | ps                | –     |
| Duty cycle distortion                      | –                        | SD/HD/3G                                        | –   | –   | 30   | ps                | –     |
| Overshoot                                  | –                        | –                                               | –   | –   | 10   | %                 | –     |
| Input Return Loss                          | –                        | 5MHz - 1.485GHz                                 | 15  | –   | –    | dB                | 5     |
|                                            |                          | 1.485GHz - 2.97GHz                              | 10  | –   | –    | dB                | 5     |
| SDI/ $\overline{SDI}$ Input Resistance     | –                        | Single-ended                                    | –   | 1.9 | –    | k $\Omega$        | –     |
| SDI/ $\overline{SDI}$ Input Capacitance    | –                        | Single-ended                                    | –   | 1.3 | –    | pF                | –     |
| DDO/ $\overline{DDO}$ Output Resistance    | –                        | Single-ended                                    | –   | 50  | –    | W                 | –     |
| Equalizer Mode Enable Delay                | –                        | –                                               | –   | 1   | –    | $\mu s$           | –     |

**Notes:**

1. Device performance is optimized for standard data rates (SD = 270Mb/s, HD = 1.485Gb/s, 3G = 2.970Gb/s).
2. 0m cable length.
3. All parts are production tested. In order to guarantee jitter over the full range of specification ( $V_{CC} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , and 720-880mV launch swing from a SMPTE compliant cable driver) the recommended applications circuit must be used.
4. Based on validation data using the recommended circuit, at  $V_{CC} = 3.3V$ ,  $T_A = 25^\circ C$  and 800mV launch swing from a SMPTE compliant cable driver.
5. IRL depends on board design. The GS3490 achieves this specification on Semtech's evaluation boards.

**Table 2-4: AC Electrical Characteristics - Cable Driver Mode**

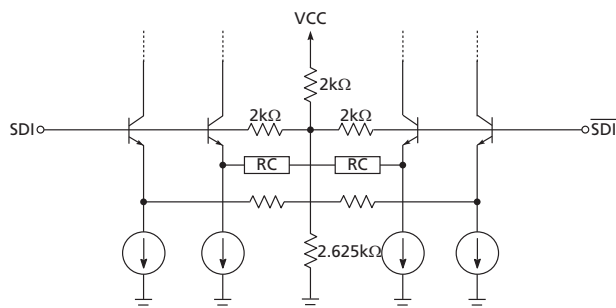
$V_{CC} = +3.3V \pm 5\%$ ,  $T_A = -20^\circ\text{C}$  to  $+85^\circ\text{C}$  (unless otherwise shown), Functional Temperature Range:  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$

| Parameter                                 | Symbol                   | Conditions                                      | Min | Typ  | Max  | Units             | Notes |
|-------------------------------------------|--------------------------|-------------------------------------------------|-----|------|------|-------------------|-------|
| Serial Data Rate                          | $DR_{DDI}$               | –                                               | 270 | –    | 2970 | Mb/s              | –     |
| Additive Jitter                           | –                        | 2.97Gb/s                                        | –   | 15   | 25   | ps <sub>pp</sub>  | –     |
|                                           |                          | 1.485Gb/s                                       | –   | 15   | 25   | ps <sub>pp</sub>  | –     |
|                                           |                          | 270Mb/s                                         | –   | 55   | 85   | ps <sub>pp</sub>  | –     |
| SDO Rise/Fall Time                        | $t_r, t_f$               | CD_SD_EN = 0, 20% - 80%                         | –   | –    | 135  | ps                | –     |
|                                           | $t_r, t_f$               | CD_SD_EN = 1, 20% - 80%                         | 400 | –    | 950  | ps                | –     |
| Mismatch in Rise/Fall Time                | $\Delta t_r, \Delta t_f$ | CD_SD_EN = 0 only                               | –   | –    | 35   | ps                | –     |
| Duty Cycle Distortion                     | –                        | CD_SD_EN = 0, 2.97Gb/s                          | –   | –    | 14   | ps                | 1, 2  |
|                                           |                          | CD_SD_EN = 0, 1.485Gb/s                         | –   | –    | 20   | ps                | 1, 2  |
|                                           |                          | CD_SD_EN = 1                                    | –   | –    | 50   | ps                | 1, 2  |
| Overshoot                                 | –                        | CD_SD_EN = 0                                    | –   | –    | 10   | %                 | 1     |
| Output Return Loss                        | ORL                      | 5MHz - 1.485GHz                                 | 15  | –    | –    | dB                | 3     |
|                                           |                          | 1.485GHz - 2.97GHz                              | 10  | –    | –    | dB                | 3     |
| SDO Output Voltage Swing                  | $\Delta V_{SDO}$         | $R_{SET} = 750\Omega$                           | 750 | 800  | 880  | mV <sub>pp</sub>  | 1     |
| DDI/ $\overline{DDI}$ Input Voltage Swing | $\Delta V_{DDI}$         | Guaranteed functional                           | 100 | –    | 250  | mV <sub>ppd</sub> | –     |
|                                           |                          | Guaranteed to meet all published specifications | 250 | –    | 2200 | mV <sub>ppd</sub> | –     |
| Cable Driver Mode Enable Delay            | –                        | –                                               | –   | 0.25 | –    | μs                | –     |

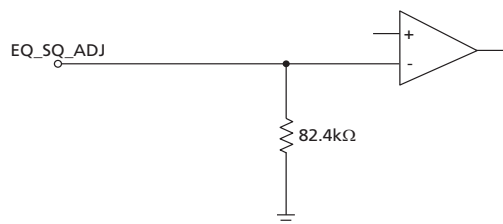
**Notes:**

1. Single-ended into 75Ω external load.
2. Calculated as the actual positive bit-width compared to the expected positive bit-width using a 1010 pattern.
3. ORL depends on board design. The GS3490 achieves this specification on Semtech's evaluation boards.

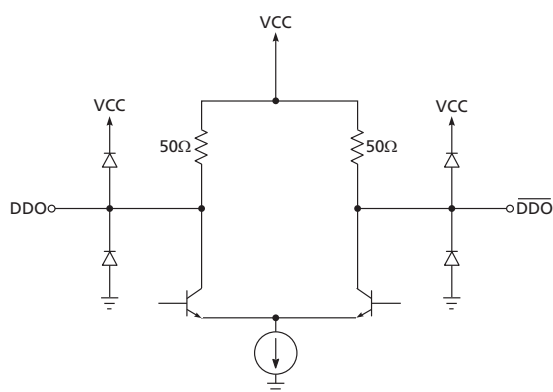
### 3. Input/Output Circuits



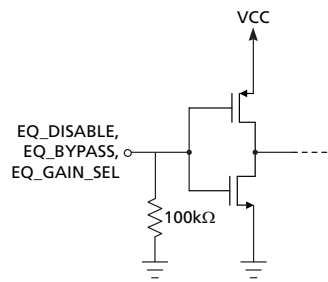
### Figure 3-1: Equalizer Serial Digital Input Circuit



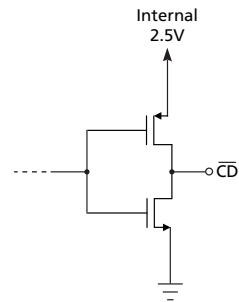
**Figure 3-2: EQ\_SQ\_ADJ Circuit**



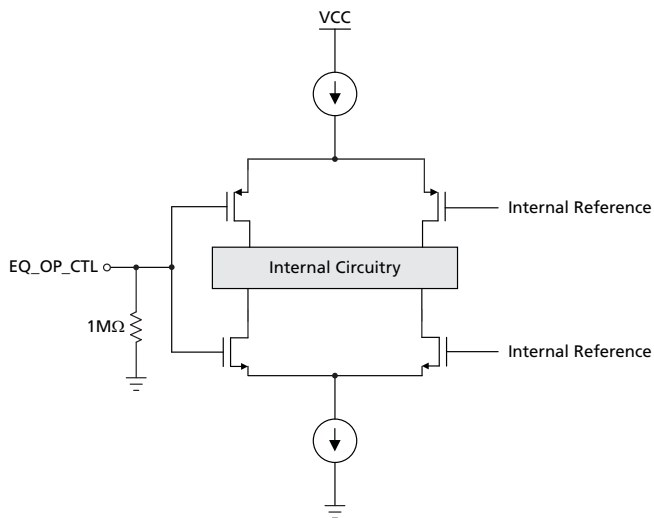
### Figure 3-3: Equalizer Differential Digital Data Output Circuit



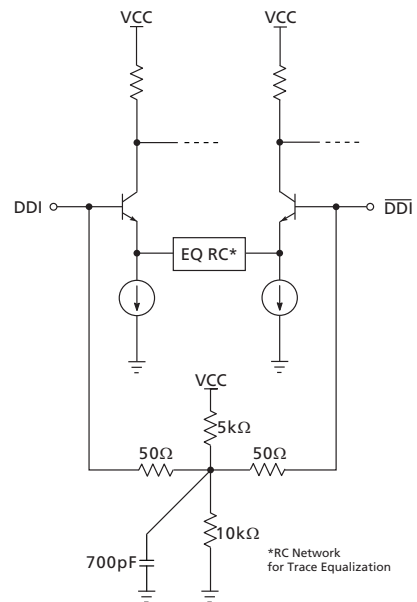
**Figure 3-4: EQ\_DISABLE, EQ\_BYPASS, EQ\_GAIN\_SEL Circuits**



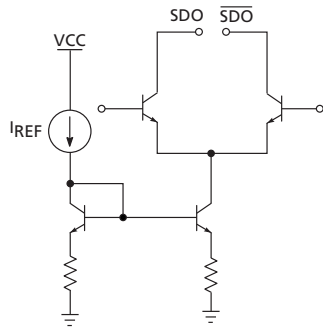
**Figure 3-5:  $\overline{CD}$  Circuit**



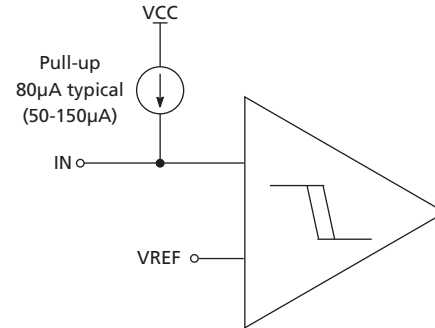
**Figure 3-6: EQ\_OP\_CTL Circuit**



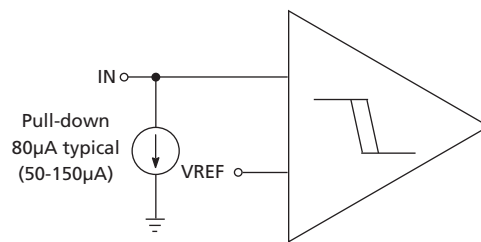
**Figure 3-7: Cable Driver Differential Digital Data Input Circuit**



**Figure 3-8: Cable Driver Serial Digital Output Circuit**



**Figure 3-9: CD\_SD\_EN Circuit**



**Figure 3-10: CD\_ENABLE Circuit**

## 4. Detailed Description

The GS3490 is a half-duplex, bi-directional device that integrates the functions of both a cable equalizer and a cable driver in one package, allowing for a single application circuit to perform both functions through a single BNC connector. The GS3490 pin out enables switching from one mode to another using a single logic control signal.

**Table 4-1: GS3490 Operating Modes**

| EQ_DISABLE | CD_ENABLE | Description       |
|------------|-----------|-------------------|
| 0          | 0         | Equalizer Mode    |
| 0          | 1         | Debug Mode*       |
| 1          | 0         | Power-Down Mode   |
| 1          | 1         | Cable Driver Mode |

**\*Note:** Data represented at the Cable Driver's digital data input is passed through the device, looped back through the Equalizer and appears on the Equalizer's digital data output. The data is looped through the device, provided the SDI/O BNC is terminated with a 75Ω load that is not driving a signal.

### 4.1 Equalizer Mode

#### 4.1.1 Equalizer Mode Enable

To enable Equalizer Mode, both the EQ\_DISABLE and CD\_ENABLE pins must be set to logic LOW. These two pins may be tied together and controlled from a single logic signal.

#### 4.1.2 Serial Digital Inputs (SDI/ $\overline{\text{SDI}}$ )

Please refer to [Section 5.1](#) for the correct way to implement the bi-directional serial input/output. Other application circuits are not supported.

#### 4.1.3 Automatic (Adaptive) Cable Equalization

The GS3490 automatically adjusts its gain to equalize and restore signals received over different lengths of coaxial cable having loss characteristics similar to Belden 8281 or 1694A. The device is designed to automatically equalize SMPTE SDI signal rates from 125Mb/s up to 2.97Gb/s and DVB-ASI signals at 270Mb/s.

The equalized signal is DC-restored, effectively restoring the logic threshold of the equalized signal to its correct level independent of shifts due to AC-coupling.

Adaptive Cable Equalization and DC Restoration can be disabled by pulling the EQ\_BYPASS pin HIGH.

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#### 4.1.4 Carrier Detect ( $\overline{\text{CD}}$ )

The Carrier Detect output pin ( $\overline{\text{CD}}$ ) indicates the presence of a signal at the input of the GS3490. When  $\overline{\text{CD}}$  is LOW, the device has detected an input on its SDI/ $\overline{\text{SDI}}$  pins. When  $\overline{\text{CD}}$  is HIGH, the device has not detected an input signal.

When EQ\_DISABLE is HIGH, the  $\overline{\text{CD}}$  output will still function to facilitate the detection of a serial input data signal. As a result, when in Equalizer Mode, auto power-down can be implemented by directly tying  $\overline{\text{CD}}$  to EQ\_DISABLE. When connected, the GS3490 will automatically go into lower power mode when there is a loss of Serial Digital Input signal.

**Note 1:**  $\overline{\text{CD}}$  will only operate correctly for data rates greater than 19Mb/s.

**Note 2:** If EQ\_SQ\_ADJ is being used to limit the maximum gain of the device, and the maximum cable length is exceeded when EQ\_BYPASS pin is set LOW, the  $\overline{\text{CD}}$  pin will be set HIGH even if a carrier is present.

**Note 3:** If the  $\overline{\text{CD}}$  pin is connected to the EQ\_DISABLE pin, EQ\_SQ\_ADJ must be either left open, or connected to ground.

#### 4.1.5 Squelch Adjust (EQ\_SQ\_ADJ)

The GS3490 features a Squelch Adjust (EQ\_SQ\_ADJ) threshold.

This feature can be useful in applications where there are multiple input channels using the GS3490, since the maximum gain can be limited to avoid crosstalk.

The EQ\_SQ\_ADJ pin acts to change the threshold of the Carrier Detect ( $\overline{\text{CD}}$ ) pin, through voltage level variances. When the input signal drops below a certain threshold, the  $\overline{\text{CD}}$  pin will be driven HIGH, indicating that there is not a valid input signal. In applications where squelch adjust is not required, the EQ\_SQ\_ADJ pin can be left unconnected.

This feature has been designed for use in applications, where signal crosstalk and circuit noise cause the equalizer to output erroneous data when no input signal is present. The use of a Carrier Detect function with a fixed internal reference does not solve this problem, since the signal-to-noise ratio on the circuit board could be significantly less than the default signal detection level set by the on-chip reference.

**Note:** When using EQ\_SQ\_ADJ to limit the maximum gain of the GS3490, auto power-down is not supported and so  $\overline{\text{CD}}$  should not be connected to EQ\_DISABLE.

#### 4.1.6 Differential Digital Data Outputs (DDO/ $\overline{\text{DDO}}$ )

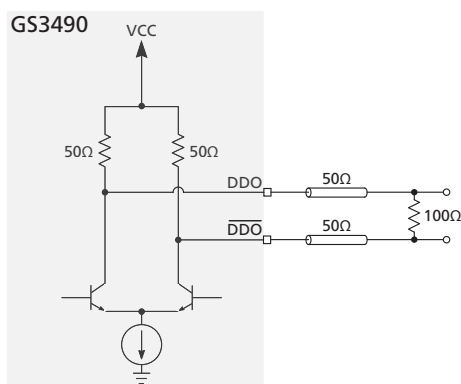
The digital data output signals have a nominal output voltage swing of either 850mV<sub>ppd</sub> or 425mV<sub>ppd</sub>, as set by the EQ\_OP\_CTL pin.

When EQ\_DISABLE is HIGH, the differential digital outputs are high impedance and will be pulled HIGH by the on-chip termination.

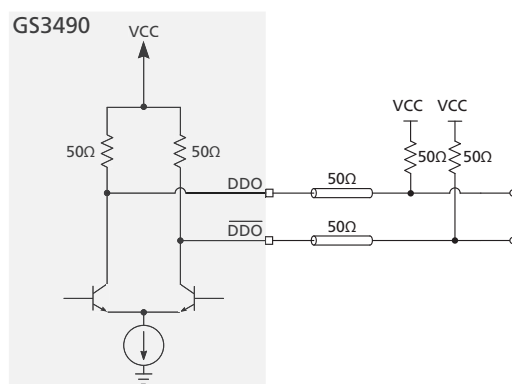
Table 4-2 shows the typical output common mode voltage levels ( $V_{\text{CMDDO}}$ ) related to the two output swing options and the type of output transmission termination as shown in Figure 4-1 and Figure 4-2.

**Table 4-2: Typical Common Mode Output Voltage Levels ( $V_{CMDDO}$ ) -  $V_{CC} = 3.3V$**

| Output Voltage Swing ( $\Delta V_{DDO}$ ) | Termination Type 1<br>(See Figure 4-1) | Termination Type 2<br>(See Figure 4-2) |
|-------------------------------------------|----------------------------------------|----------------------------------------|
| 425mV <sub>ppd</sub>                      | 3.09V                                  | 3.19V                                  |
| 850mV <sub>ppd</sub>                      | 2.88V                                  | 3.09V                                  |



**Figure 4-1: 100Ω Parallel Output Termination**



**Figure 4-2: 50Ω Termination to VCC**

#### 4.1.7 Adjustable Output Swing, De-Emphasis and Mute (EQ\_OP\_CTL)

The EQ\_OP\_CTL input pin determines the output swing and De-emphasis settings for DDO/ $\overline{DDO}$ .

The EQ\_OP\_CTL pin is an analog input allowing different combinations of output swing, De-emphasis and mute. The possible values are listed in Table 4-3 below:

**Table 4-3: EQ\_OP\_CTL Functions and Levels**

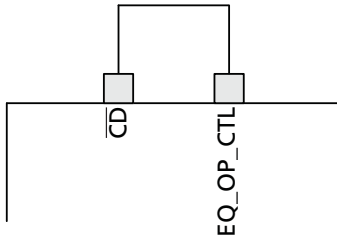
| Level | Swing (mV <sub>ppd</sub> ) | De-emphasis | Mute | Voltage (V)   |
|-------|----------------------------|-------------|------|---------------|
| 0     | 850                        | Off         | N    | 0.000 - 0.083 |
| 1     | 850                        | 2dB         | N    | 0.234 - 0.394 |
| 2     | 850                        | 4dB         | N    | 0.545 - 0.704 |
| 3     | 850                        | 6dB         | N    | 0.856 - 1.015 |
| 4     | 425                        | Off         | N    | 1.166 - 1.333 |
| 5     | 425                        | 2dB         | N    | 1.484 - 1.644 |
| 6     | 425                        | 4dB         | N    | 1.795 - 1.954 |
| 7     | 425                        | 6dB         | N    | 2.106 - 2.265 |
| 8     | 425                        | N/A         | Y    | 2.416 - 2.500 |

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When muted, the output swing is set to  $425\text{mV}_{\text{ppd}}$  and the  $\text{DDO}/\overline{\text{DDO}}$  outputs are latched.

Automatic muting of the output can be enabled by connecting the  $\overline{\text{CD}}$  pin to the  $\text{EQ\_OP\_CTL}$  pin.

If the connection is made directly, as shown in Figure 4-3, the output would be in its default mode ( $850\text{mV}_{\text{ppd}}$  swing with no De-emphasis) when there is a signal present.



**Figure 4-3: Direct Loopback**

## 4.2 Cable Driver Mode

### 4.2.1 Cable Driver Mode Enable

To enable Cable Driver Mode,  $\text{EQ\_DISABLE}$  and  $\text{CD\_ENABLE}$  must be set to logic HIGH. These two pins may be tied together and controlled from a single logic signal.

### 4.2.2 Differential Digital Data Inputs ( $\text{DDI}/\overline{\text{DDI}}$ )

The GS3490 features a differential input buffer ( $\text{DDI}/\overline{\text{DDI}}$ ) with on-chip  $100\Omega$  differential termination.

The differential data input signal is connected to the  $\text{DDI}$  and  $\overline{\text{DDI}}$  input pins of the device.

The serial data input buffer is capable of operation with any binary coded signal that meets the input signal level requirements, in the range of  $270\text{Mb/s}$  to  $2.97\text{Gb/s}$  in Cable Driver Mode. The input circuit is self-biasing to allow for simple AC or DC-coupling of input signals to the device.

### 4.2.3 Serial Data Outputs ( $\text{SDO}/\overline{\text{SDO}}$ )

The GS3490 features a current-mode differential output driver capable of achieving output swings up to  $1040\text{mV}_{\text{pp}}$  using a  $3.3\text{V}$  termination supply ( $V_{\text{TERM}}$ ).

The output signal amplitude or swing is set using an external  $R_{\text{SET}}$  resistor. For the most commonly used output swing configurations, please refer to Section 4.2.5.

The  $\text{SDO}/\overline{\text{SDO}}$  pins of the device provide the serial data outputs.

Please refer to Section 5.1 for the correct way to implement the bi-directional serial input/output. Other application circuits are not supported.

## 4.2.4 Slew Rate Selection (CD\_SD\_EN)

The GS3490 supports two output slew rates on SDO/ $\overline{\text{SDO}}$ .

Control of the slew rate is determined by the setting of the CD\_SD\_EN input pin.

**Table 4-4: Slew Rate Selection**

| CD_SD_EN | Rise/Fall Time                        |
|----------|---------------------------------------|
| 0        | SMPTE ST 424 & SMPTE ST 292 compliant |
| 1        | SMPTE ST 259 compliant                |
| Floating | SMPTE ST 259 compliant                |

## 4.2.5 Output Amplitude (R<sub>SET</sub>)

The output amplitude of the GS3490 can be adjusted by changing the value of the R<sub>SET</sub> resistor as shown in Table 4-5. For an 800mV<sub>pp</sub> output with a nominal  $\pm 7\%$  tolerance, a value of 750 $\Omega$  is required. A  $\pm 1\%$  SMT resistor should be used.

The R<sub>SET</sub> resistor is part of an internal DC feedback loop in the GS3490. The resistor should be placed as close as possible to the RSET pin, and connected directly to the VCC plane with more than one via to minimize inductance (traces/wires may cause instability).

**Note:** Care should be taken when considering layout of the R<sub>SET</sub> resistor. Please refer to Section 5.2 for more details.

**Table 4-5: Typical R<sub>SET</sub> Values**

| Output Swing (mV <sub>pp</sub> ) | R <sub>SET</sub> ( $\Omega$ ) | R <sub>TERM</sub> ( $\Omega$ ) | V <sub>TERM</sub> (V) |
|----------------------------------|-------------------------------|--------------------------------|-----------------------|
| 1040                             | 576                           | 75                             | 3.3                   |
| 800                              | 750                           | 75                             | 3.3                   |
| 500                              | 1210                          | 75                             | 3.3                   |

**Note 1:** Actual swing values may vary based on layout.

**Note 2:** R<sub>SET</sub> is the resistor connected from pin 27 to VCC (refer to Figure 5-1).

**Note 3:** R<sub>TERM</sub> is the SDO/ $\overline{\text{SDO}}$  pull up resistor.

## 5. Application Information

### 5.1 Typical Application Circuit

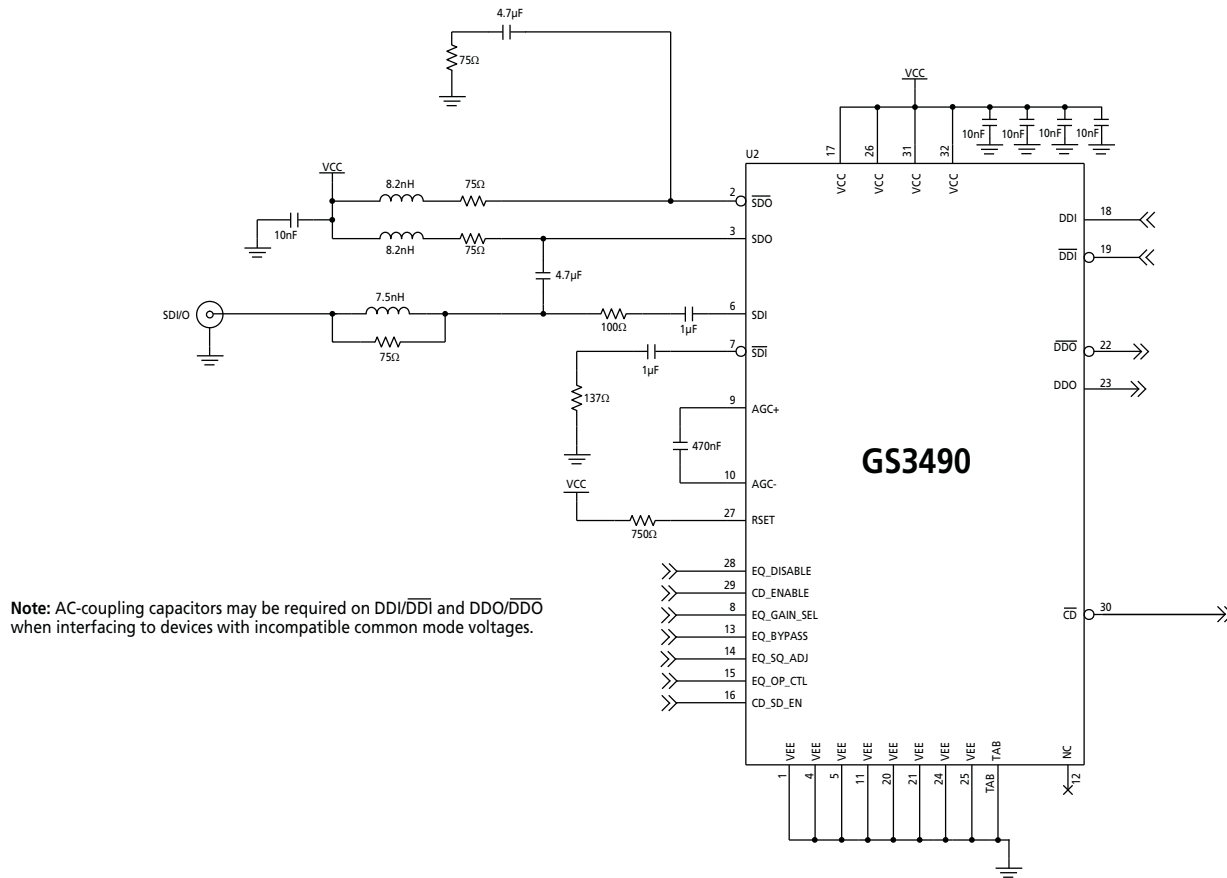


Figure 5-1: GS3490 Typical Application Circuit

### 5.2 PCB Layout

Special attention must be paid to component layout when designing Serial Digital Interfaces for HDTV. A FR-4 dielectric can be used, however, controlled impedance transmission lines are required for PCB traces longer than approximately 1cm. Note the following PCB artwork features used to optimize performance:

- PCB trace width for 3Gb/s rate signals is closely matched to SMT component width to minimize reflections due to change in trace impedance.
- High-speed traces are curved to minimize impedance changes.

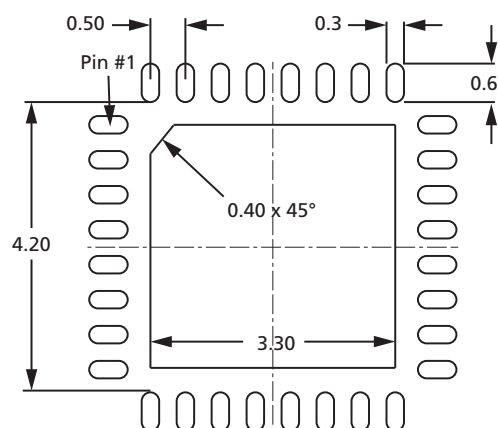
Cutouts in the inner layers should be used under the GS3490 input and output components to minimize parasitic capacitance. For more detail on this and other layout recommendations, please refer to A Guide For Designing With Semtech's 3G-SDI Equalizers (Doc ID: GENDOC-055280).



## 6.2 Packaging Data

| Parameter                                                                | Value                                    |
|--------------------------------------------------------------------------|------------------------------------------|
| Package Type                                                             | 32-pin QFN / 5mm x 5mm / 0.5mm pad pitch |
| Moisture Sensitivity Level                                               | 3                                        |
| Junction to Case Thermal Resistance, $\theta_{j-c}$                      | 17.8°C/W                                 |
| Junction to Air Thermal Resistance, $\theta_{j-a}$ (at zero airflow)     | 26.4°C/W                                 |
| Psi ( $\psi$ ) = Junction-to-Top (of Package) Characterization Parameter | 0.4°C/W                                  |
| Pb-free and RoHS compliant                                               | Yes                                      |

## 6.3 Recommended PCB Footprint



### Notes:

1. All dimensions in mm.
2. Drawing not to scale.
3. 16 thermal VIAs, evenly spaced on centre paddle connected to ground plane.

**Figure 6-2: Recommended PCB Footprint**

# 6.4 Marking Diagram

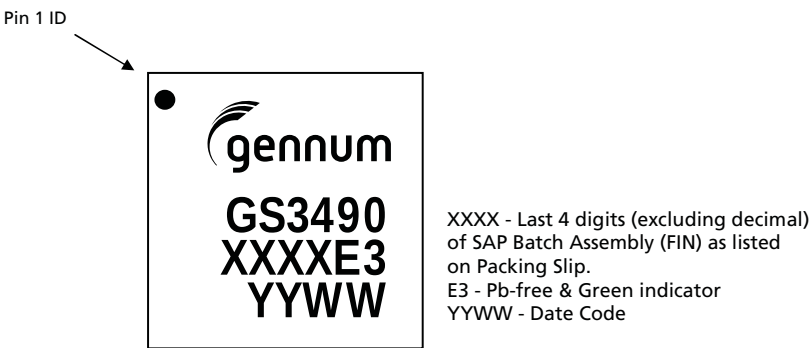


Figure 6-3: Marking Diagram

# 6.5 Solder Reflow Profiles

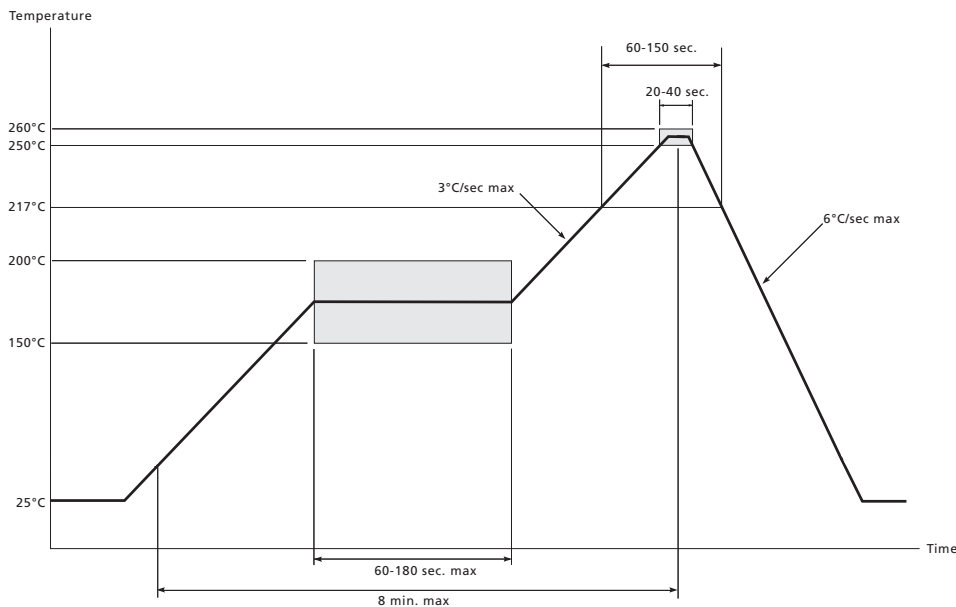


Figure 6-4: Maximum Pb-free Solder Reflow Profile

# 6.6 Ordering Information

| Part   | Part Number | Package    | Temperature Range |
|--------|-------------|------------|-------------------|
| GS3490 | GS3490-INE3 | 32-pin QFN | -40°C to 85°C     |



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**DOCUMENT IDENTIFICATION**  
**FINAL DATA SHEET**

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