## *Advance Product Information*

# *VSC7927*

*SDH/SONET 2.5Gb/s*
*Laser Diode Driver*

## *Features*

- Rise Times Less Than 100ps
- High Speed Operation (Up to 2.5 Gb/s NRZ Data)
- Differential or Single-Ended Inputs
- Single Supply
- ECL Compatible Clock and Data Inputs
- Direct Access to Modulation and Bias FET's
- Data Density Monitors
- On-chip Reclocking Register
- On-chip Mux for Clocked or Non-clocked Applications
- On-chip 50 Ohm Input Termination: Clock and Data

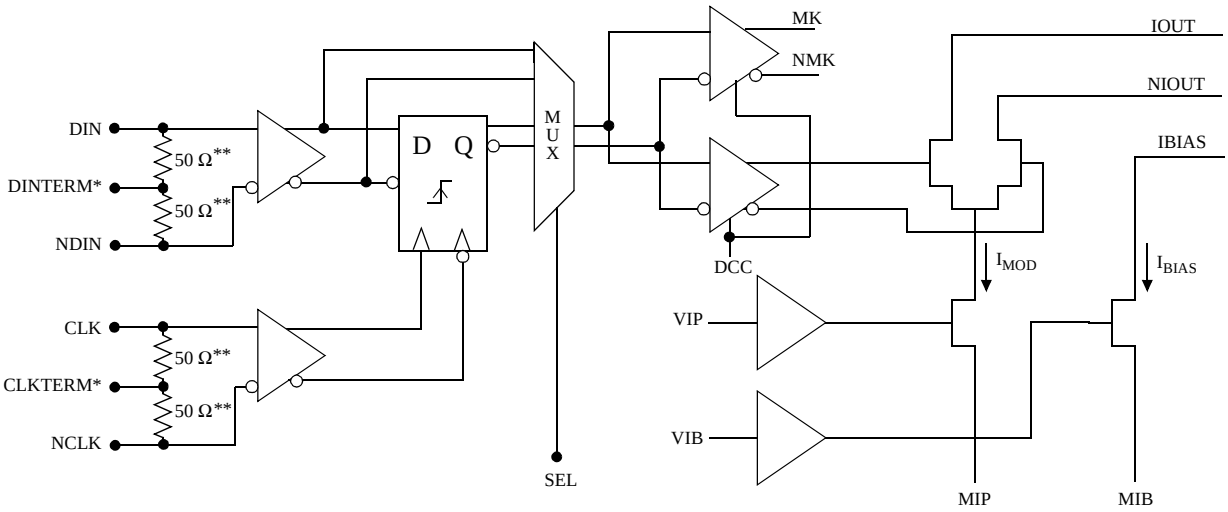
## *Introduction*

The VSC7927 is a single 5V supply, 2.5 Gb/s laser diode driver with direct access to the laser modulation and bias FET's. Laser bias and modulation currents are set by external components allowing precision monitoring and setting of the current levels. Data density outputs are provided to allow the user to adjust the laser bias in high unbalanced data applications. Clock and data inputs are differentially terminated to 50 Ohms.

## *Applications*

- SDH/SONET @ 622Mb/s, 1.244Gb/s, 2.488Gb/s
- Full Speed Fibre Channel (1.062Gb/s)

## *VSC7927 Block Diagram*




*Terminated to Off-chip Capacitor
**On Die Components




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**Table 1: Signal Pin Reference**

| *Signal* | *Type* | *Level* | *# Pins* | *Description* |
|---|---|---|---|---|
| DIN, NDIN | In | ECL | 2 | Data Input and Data Reference, On-chip 50¾ Termination |
| MK, NMK | Out | ECL | 2 | Data Density Differential Outputs |
| NIOUT | Out | — | 1 | Laser Modulation Current Output (Complementary) |
| IOUT | Out | — | 1 | Laser Modulation Current Output (To Laser Cathode) |
| VSS | Pwr | Pwr | 2 | Negative Voltage Rail |
| GND | Pwr | Pwr | 5 | Positive Voltage Rail |
| VIP | In | DC | 1 | Modulation Gate Node |
| MIP | In | DC | 1 | Modulation Source Node |
| VIB | In | DC | 1 | Bias Gate Node |
| MIB | In | DC | 1 | Bias Source Node |
| IBIAS | Out | DC | 1 | Laser Bias Output (To Laser Cathode) |
| CLK, NCLK | In | ECL | 2 | Clock Input and Clock Reference, On-chip 50¾ Termination |
| DINTERM | In | DC | 1 | Data Reference |
| CLKTERM | In | DC | 1 | Clock Reference |
| DCC | In | DC | 1 | Duty Cycle Control, Leave Floating |
| SEL | In | DC | 1 | Clk/Non-clk Data Select |
| Total Pins | — | — | 24 | |

**Table 2: Mux Select Logic Table**

| *SEL* | *Mode Select* |
|---|---|
| $V_{SS}$ | Clocked Data In |
| GND | Non-clocked Data In |
| N/C | Non-clocked Data In |

**Table 3: Absolute Maximum Ratings**

| *Symbol* | *Rating* | *Limit* |
|---|---|---|
| $V_{SS}$ | Negative Power Supply Voltage | $V_{CC}$ to -6.0V |
| $T_j$ | Maximum Junction Temperature | -55C to + 125C |
| $T_{stg}$ | Storage Temperature | -65C to +150C |



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**Table 4: High Speed Inputs and ECL Outputs**

| *Symbol* | *Parameter* | *Min* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|
| $V_{IN}$ | Single-ended Input Voltage Swing | 300 | 1500 | mVp-p | $V_{CM}$ = -2.0V |
| $V_{CM}$ | Differential Input Common Mode Range | -2.3 | -1.3 | V | $V_{SS}$ = -5.2V |
| $V_{OH}$ | ECL Output High Voltage | -1200 | — | mV | 50 Ohms to -2.0V |
| $V_{OL}$ | ECL Output Low Voltage | — | -1600 | mV | 50 Ohms to -2.0V |
| $V_{IN}$ | On-Chip Terminations | 35 | 65 | Ohms | — |

**Table 5: Recommended Operating Conditions**

| *Symbol* | *Parameter* | *Min* | *Typ* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|---|
| GND | Positive Voltage Rail | — | 0 | — | V | — |
| VSS | Negative Voltage Rail | -5.5 | -5.2 | -4.9 | V | — |
| $Tc_l$ | *Operational Temperature | -40 | — | 85** | C | Power dissipation = 1.3W |
| Tj | Junction Temperature | — | — | 125 | C | — |

**Lower limit of specification is ambient temperature and upper limit is case temperature.*
***See section "Calculation of the Maximum Case Temperature" for detailed maximum temperature calculations.*

**Table 6: Power Dissipation**

| *Symbol* | *Parameter* | *Min* | *Typ* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|---|
| $I_{VSS}$ | Power Supply Current (VSS) | — | —- | 120 | mA | $V_{SS}$ = -5.5, $I_{MOD}$ = $I_{BIAS}$ = 0 mA, MK/NMK open circuit |
| Pd | Total Power Dissipation | — | — | 700 | mW | $V_{SS}$ = -5.5, $I_{MOD}$ = $I_{BIAS}$ = 0 mA, Rload = 25 Ohms to GND, MK/NMK terminated 50Ω to -2V |

**Table 7: Laser Driver DC Electrical Specifications**

| *Symbol* | *Parameter* | *Min* | *Typ* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|---|
| $I_{BIAS}$ | Programmable Laser Bias Current | 2 | — | 100 | mA | — |
| $I_{MOD}$ | Programmable Modulation Current | 2 | — | 100 | mA | — |
| $V_{IB}$ | Laser Bias Control Voltage | — | — | $V_{SS}$ + 2.1 | V | $I_{BIAS}$ = 50 mA |
| $V_{IP}$ | Laser Modulation Control Voltage | — | — | $V_{SS}$ + 2.1 | V | $I_{MOD}$= 60 mA |
| $V_{OCM}$ | Output Voltage Compliance | — | GND -3V | — | V | $V_{SS}$ = -5.2V |




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**Table 8: Laser Driver AC Electrical Specifications**

| *Symbol* | *Parameter* | *Min* | *Typ* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|---|
| $t_r$ $t_f$ | Output Rise and Fall Times | — | — | 100 | ps | 25 Ohm load, 20%-80%, 20mA < $I_{MOD}$ < 60mA, $I_{BIAS}$ = 60mA |
| $t_{su}$ | t Setup Data to Clock | — | 50 | 90 | ps | — |
| $t_h$ | t Hold | 20 | 50 | — | ps | — |

**Table 9: Package Thermal Specifications**

| *Symbol* | *Parameter* | *Min* | *Typ* | *Max* | *Units* | *Conditions* |
|---|---|---|---|---|---|---|
| $\theta_{JCC}$ | Thermal Resistance from Junction to Case | — | 25 | — | °C/W | Ceramic Package |



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## Calculation of the Maximum Case Temperature

The VSC7927 is designed to operate with a maximum junction temperature of 125°C. The rise from the case to junction is determined by the power dissipation of the device. The power dissipation is determined by the $V_{SS}$ current plus the operating $I_{MOD}$ and $I_{BIAS}$ currents.

The power of the chip is determined by the following formula:

$$P_D = (-V_{SS} * I_{SS}) + ((V_{IOUT} - V_{SS}) * I_{MOD}) + ((V_{IBIAS} - V_{SS}) * I_{BIAS})$$

For example with:

$V_{SS}$ = -5.2V
$I_{MOD}$ = 40mA
$I_{BIAS}$ = 20mA
$V_{IBIAS}$ = -2.0V
$V_{IOUT}$ = -2.0V

$$P_D = (-5.2 * 150mA) + ((5.2 - 2.0) * 40mA) + ((5.2 - 2.0) * 20mA)$$

$$P_D = 780mW + 128mW + 64mW = 972mW$$

The thermal rise from junction to case is $\theta_{JC} * P_D$. For the metal glass package, $\theta_{JC}$ = 32 °C/W. Thus the thermal rise is:

32°C/W * 1.336W = 31.1°C

The maximum case temperature is:

125°C – 31.1°C = 93.9°C

The absolute maximum power dissipation of the device is at:

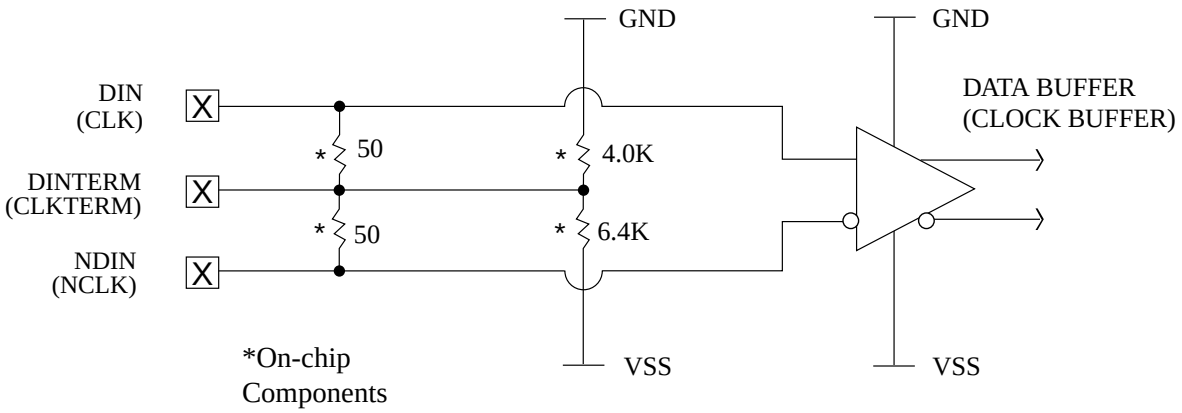
$V_{SS}$ = -5.5V
$I_{MOD}$ = 60mA
$I_{BIAS}$ = 50mA
$V_{IBIAS}$ = 0V
$V_{IOUT}$ = 0V

$$P_D = (5.5 * 150mA) + (5.5 * 60mA) + (5.5mA * 50mA) \quad P_D = 1.43W$$

This will net a maximum junction to case thermal rise of: 1.43W * 32°C/W = 45.8°C

This situation will allow maximum case temperature of: 125°C – 58°C = 79.2°C

**Figure 1: On-chip Data and Clock Input Configuration**




DINTERM to -2.0V for Differential ECL Inputs

**Figure 2: Single Ended Operation**

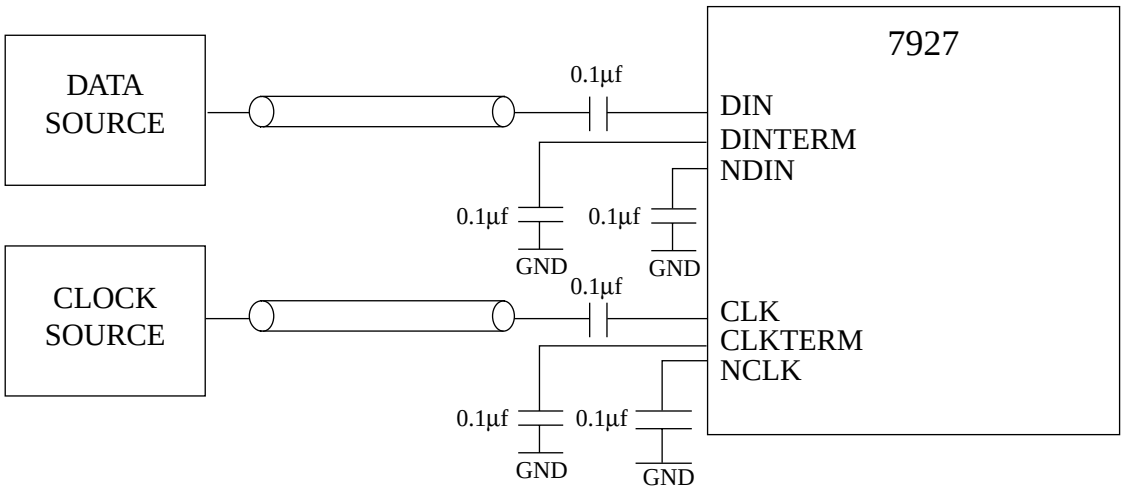





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**Figure 3: Single Ended AC Coupled**

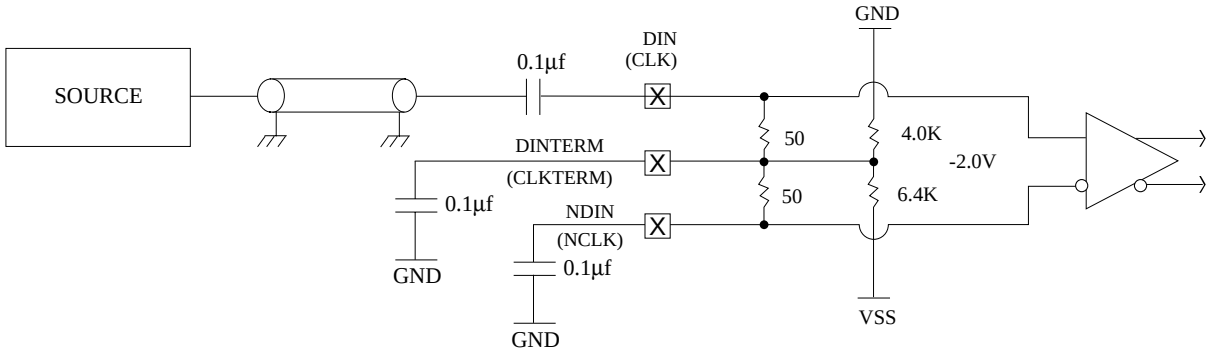


**Figure 4: Differential AC Coupled**

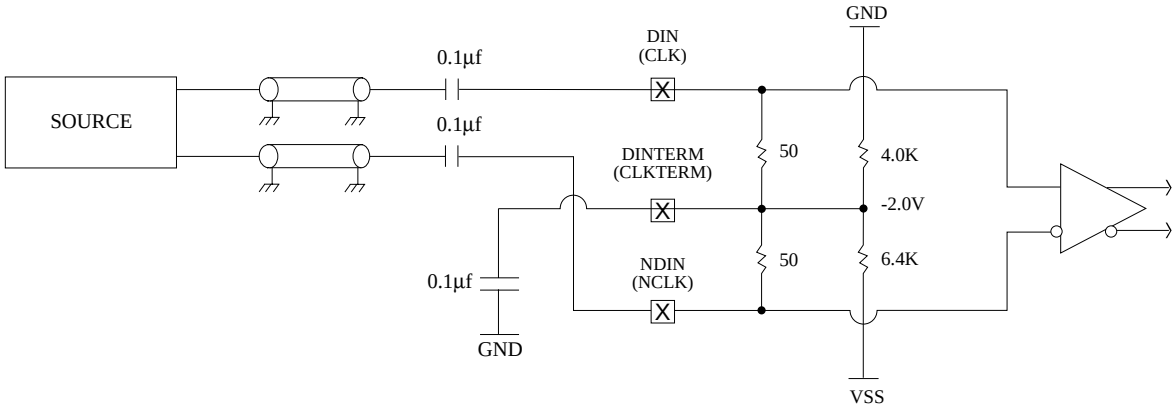


**Figure 5: Differential DC Coupled**

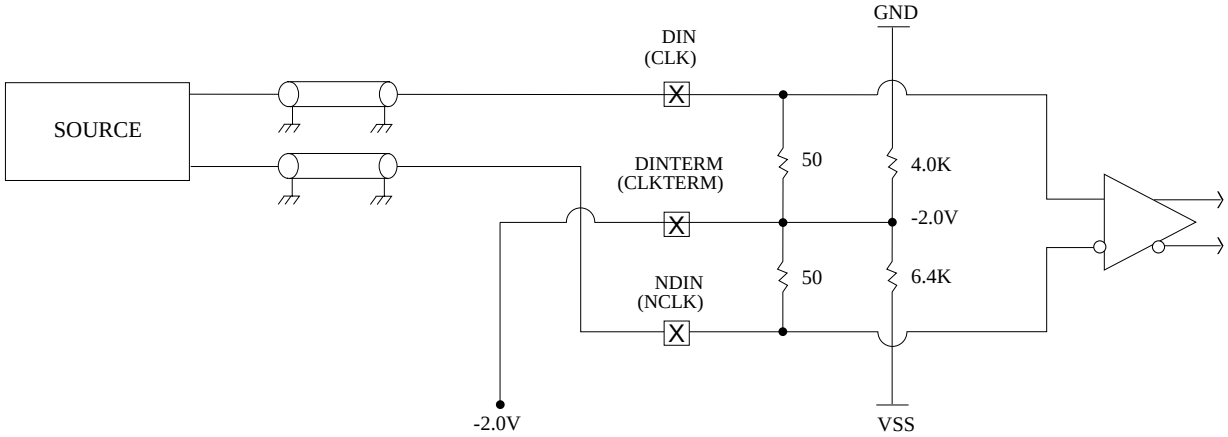





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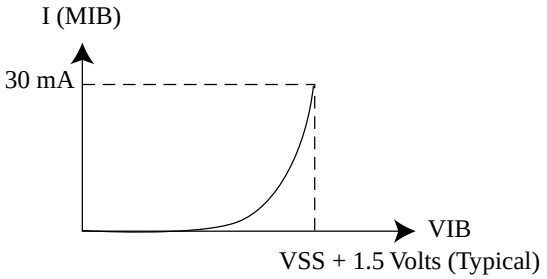
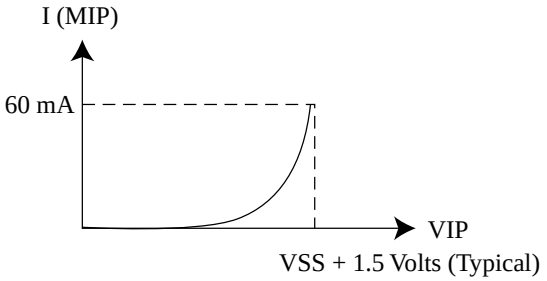
**Figure 6: Control Signals VIP and VIB**




Typical Bias Current v.s. Bias Voltage




Typical Modulation Current v.s. Modulation Voltage

**Figure 7: Simplified Output Structure**

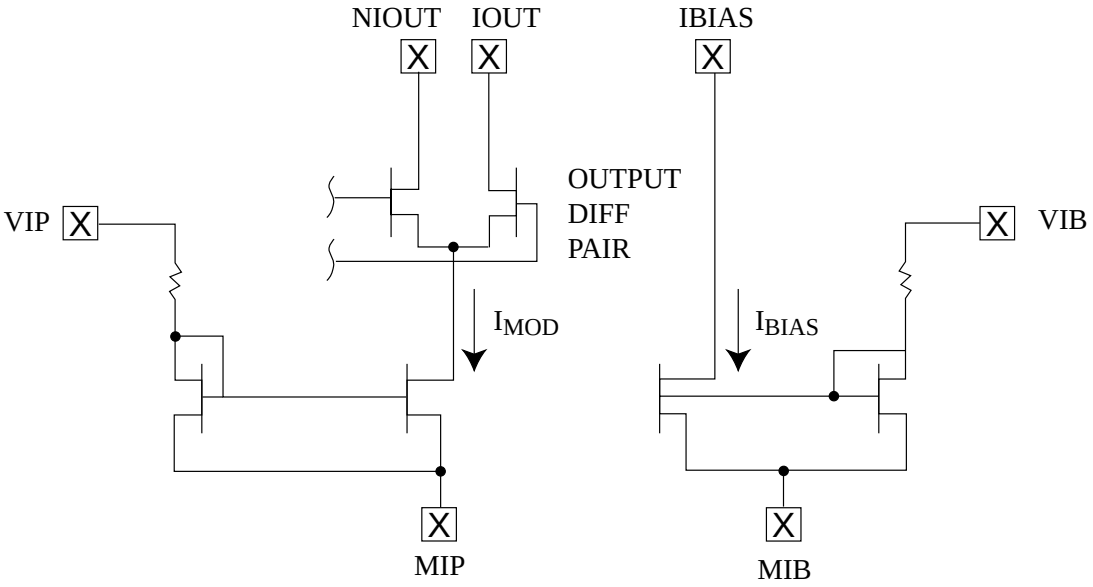





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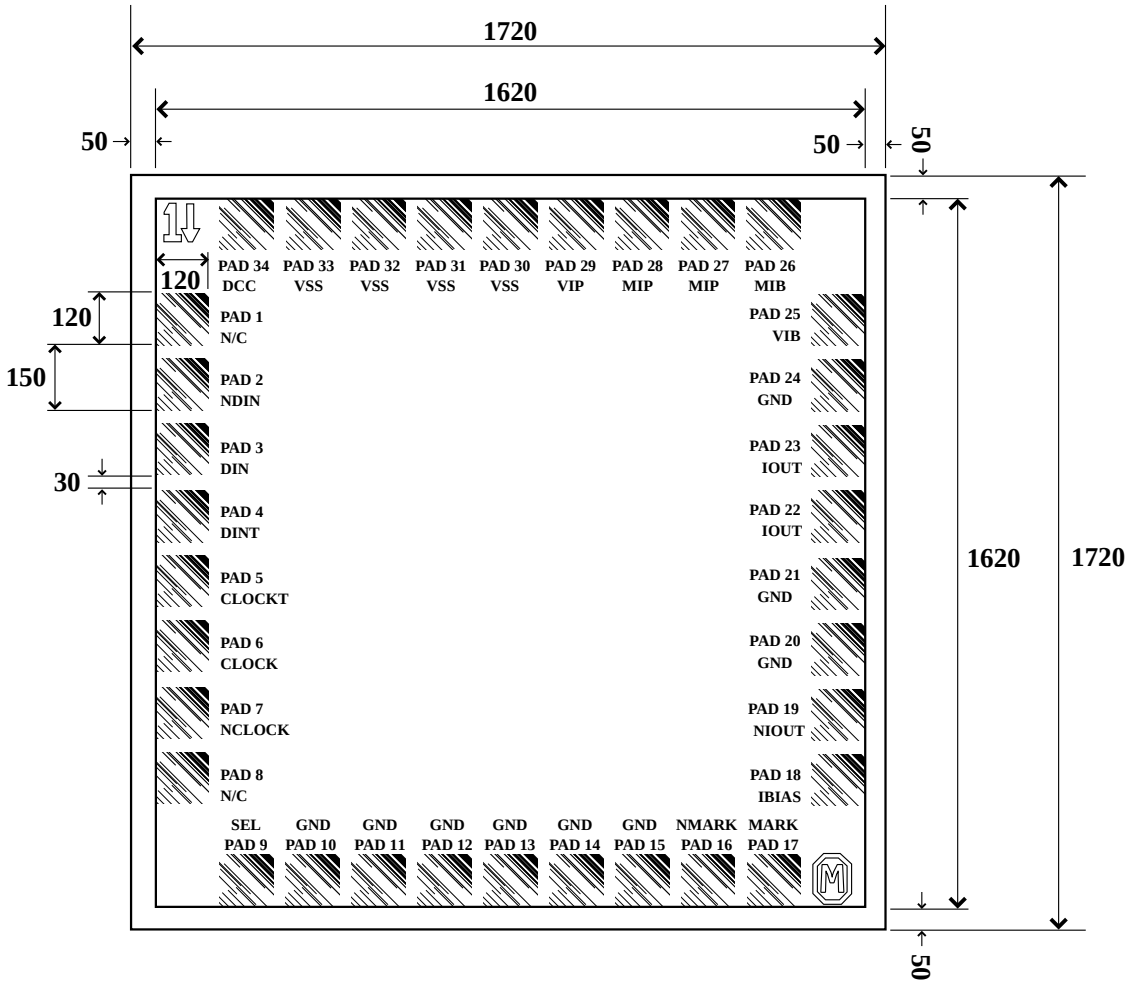
**Figure 8: Pad Assignments for VSC7927 Die**




*Notes:*
*1) Die size = 1620 X 1620*
*2) Actual die size = 1720 X 1720 (After the die are sawn up)*
*3) Pad size = 120 X 120 Microns*
*4) Pad pitch = 150*
*5) Space betwen pads = 30*

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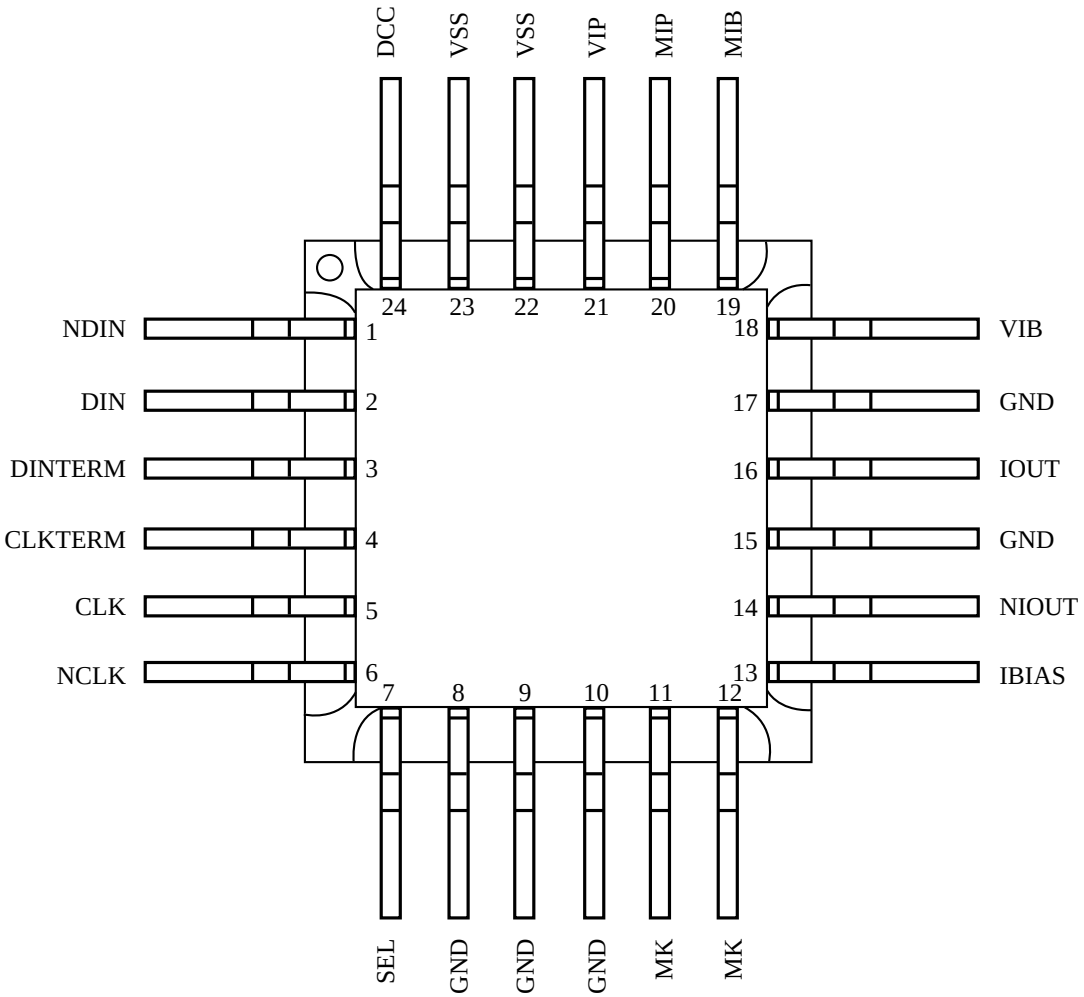
## *Pin Diagram for 24 Pin Ceramic Package*




***Note:*** ***Package lid and bottom heat spreader are electrically connected to GND within the package.***



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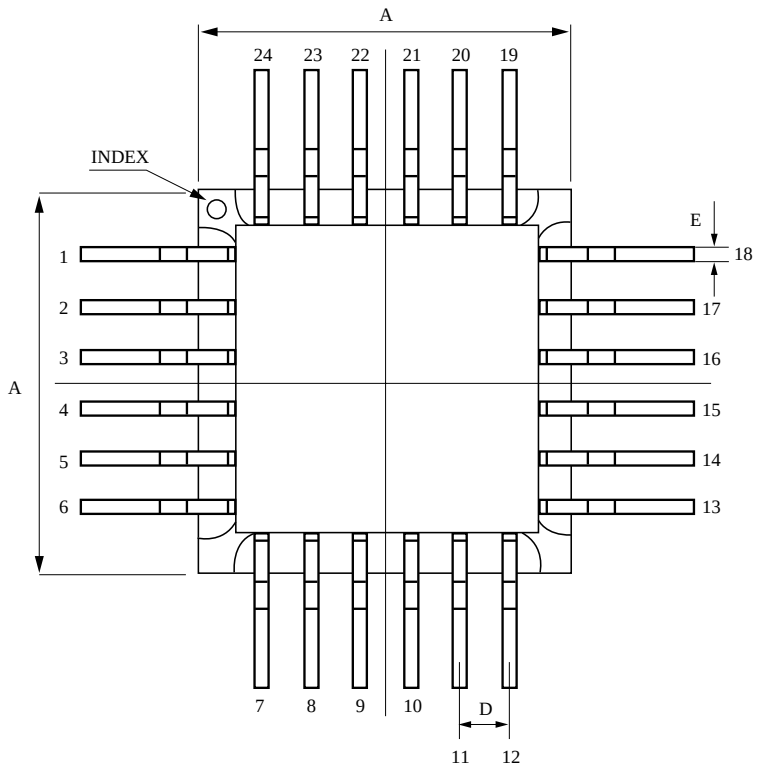
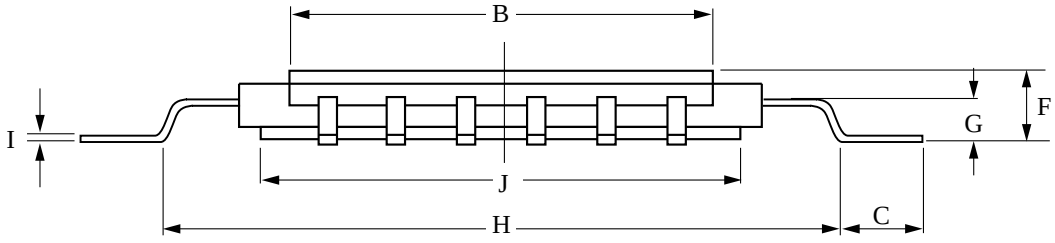
## Package Information - 24 Pin Ceramic Package (Formed Leads)

***Top View***




| *Key* | *mm* | *In* |
|---|---|---|
| A | 9.5 | 0.374 |
| B | 7.7 | 0.303 |
| C | 2.0 | 0.079 |
| D | 1.27 | 0.050 |
| E | 0.30 | 0.012 |
| F | 1.7 | 0.067 |
| G | 0.6 | 0.024 |
| H | 11.5 | 0.453 |
| I | 0.125 | 0.005 |
| J | 8.51 | 0.335 |

***Side View***




*NOTES: Drawing not to scale.*
*Package #: 101-000-0 Issue #:1*

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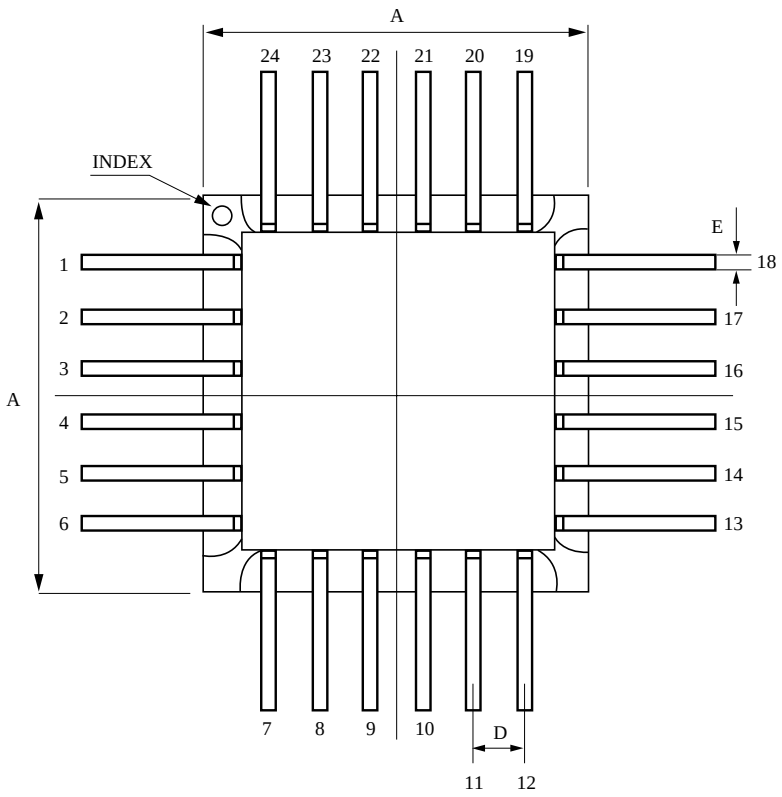
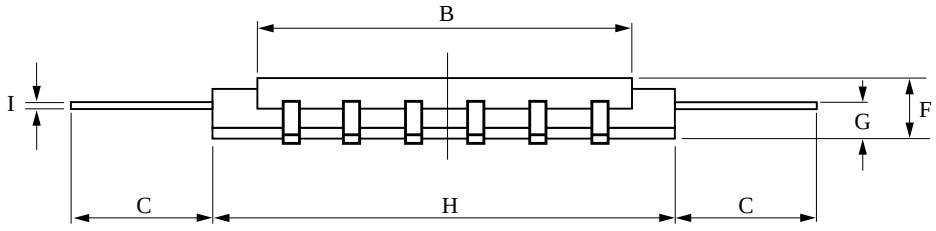
## *Package Information - 24 Pin Ceramic Package (Straight Leads)*

***Top View***




| *Key* | *mm* | *In* |
|---|---|---|
| A | 9.5 | 0.374 |
| B | 7.7 | 0.303 |
| C | 5.8 | .230 |
| D | 1.27 | 0.050 |
| E | 0.30 | 0.012 |
| F | 1.7 | 0.067 |
| G | 0.6 | 0.024 |
| H | 9.53 | 0.375 |
| I | 0.125 | 0.005 |
| J | 8.51 | 0.335 |

***Side View***




*NOTES: Drawing not to scale.*
*Package #: 101-000-0 Issue #:1*

## *Ordering Information*

The order number for this product is formed by a combination of the device number, and package style.

**VSC7927** **XXX-T** Tape and Reel Devices

**Device Type**
VSC7927: 2.5Gb/s Laser Diode Driver

**Package Style**
KF: (Ceramic - Straight Leads)
KFL: (Ceramic- Formed Leads)
KFRL: (Ceramic - Reversed Formed Leads}*
X : (Bare Die)

*Optional Reversed Formed Leads: Package leads have the same profile and dimensions, but heat spreader is away from board. Please contact the factory for additional information.

## *Notice*

This document contains information about a new product during its fabrication or early sampling phase of development. The information in this document is based on design targets, simulation results or early prototype test results. Characteristic data and other specifications are subject to change without notice. Therefore the reader is cautioned to confirm that this datasheet is current prior to design or order placement.

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