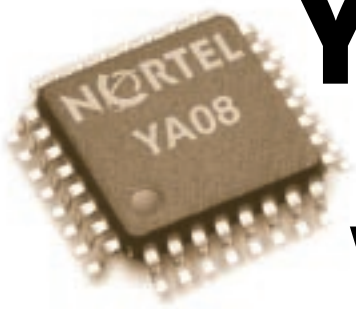
Preliminary



YA08 2.5 Gb/s Laser Diode Driver with Mean Power Control

Data Sheet

Features

Full mean power control operation

CMOS compatible laser disable input

Bias current range: 5 mA to 100 mA

Modulation current range: 10 mA to 80 mA

Fully differential data input, PECL and CML compatible

On-chip bias current limiting

On-chip 50 Ω termination at the data inputs

Minimal external components required

Single +5 V power supply operation

Operating temperature range: -40°C to 85°C

Industry standard packaging

Manufactured using the high performance, high yield NT25 bipolar process

Meets or exceeds all relevant ANSI, ITU and Bellcore specifications

Applications

SONET/SDH-based transmission systems, test equipment and modules

OC-48 fiber optic modules and line termination

WDM for 2.5 Gb/s SONET applications

ATM over SONET/SDH

Section repeaters, muxes, terminators, broadband cross-connects

The Nortel Networks YA08 Laser Diode Driver IC is a cost-effective laser diode driver with integrated mean power control. It runs at data rates up to 2.5 Gb/s and has PECL/CML compatible differential inputs. The CML inputs of the YA08 are configured to interface directly with the Nortel Networks YA19 16:1 Multiplexer and YA26 4:1 Multiplexer.

The Microelectronics Group of Nortel Networks offers a portfolio of optical networking ICs for use in high-performance optical transmitter and receiver functions.

The YA08 is part of our family of 2.5 Gb/s components, which provides for power and chip-count savings that translate into better utilization of board real-estate and ultimately cost savings to the designer of fibre-based datacom or telecom solutions.

The device is fabricated using Nortel Networks' NT25 high yield, silicon bipolar process. Each product is available in industry-standard packaging.

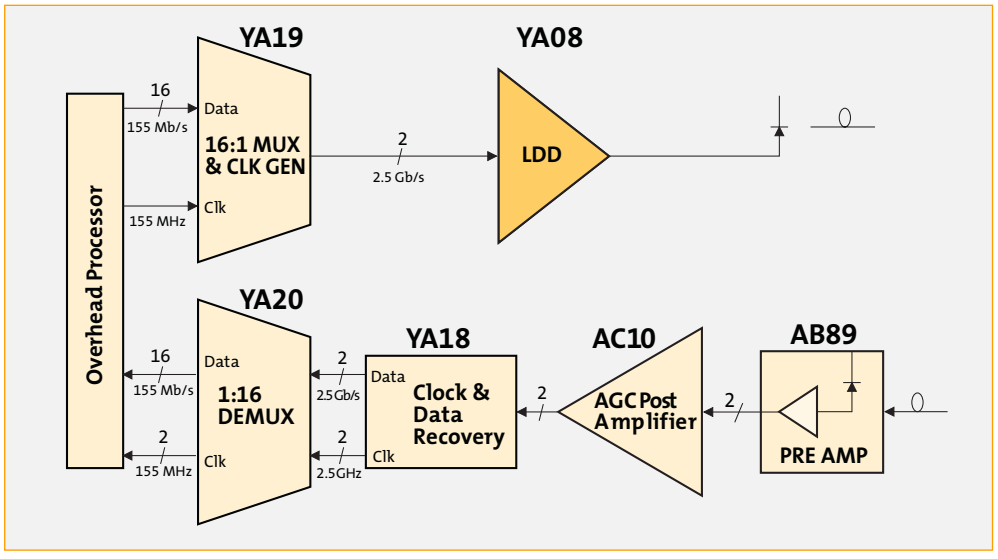


Figure 1: System Block Diagram

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Functional Description

The YA08 comprises a data input buffer, modulation switch and mean power control loop. It also features bias current limiting, laser shutdown and provides a means of monitoring the bias current externally.

An on-chip voltage reference ensures stable output currents over temperature and power supply ranges.

Input Buffer

The YA08 input buffer accepts peak differential CML or PECL input voltages of nominally 400 mV at the data input pins, TXDATIP and TXDATIN. These levels are provided directly by the YA19 and YA26 multiplexers.

Modulation Driver Circuit

The YA08 has differential outputs MODOUTP and MODOUTN, although the laser diode must only be connected to MODOUTN. The laser modulation current is controlled by a single external resistor connected between MODSET and GND. The current can be preset to any value between 10 mA and 80 mA. Details of required resistor values are found in the Applications section of this datasheet.

The laser diode cathode is connected to MODOUTN, with the anode connected to the power supply. For laser shutdown, an input allows current to be diverted from the MODOUTN pin irrespective of the data input state.

Mean Power Control Circuit

The device incorporates a mean power control loop that senses the output from a back facet monitor diode to control the laser bias current.

This loop maintains a constant, temperature independent current in the monitor diode which is connected between PININ and the power supply. This current is programmed with an external resistor connected to the PINSET pin. The bias current can be set to any value between 1 mA (start of life) and 100 mA (end of life). For details of component values see the Applications Information section.

Bias Current Limiter

A bias current limiter circuit prevents the laser bias current from exceeding an externally programmable threshold. This threshold current can be preset to any value between 40 mA and 100 mA by connecting a resistor between the LIMITSET pin and ground.

Bias Mirror Output

The BIASMIRR pin provides an external means of monitoring the bias current. The ratio between bias current and BIASMIRR current is set internally to 12.

Laser Shutdown Input

The LD pin is a CMOS-compatible laser shutdown input. The polarity of this input is set by the state of the LDSET pin. A logic '1' on LDSET configures the LD pin so that a logic '1' shuts down the laser.

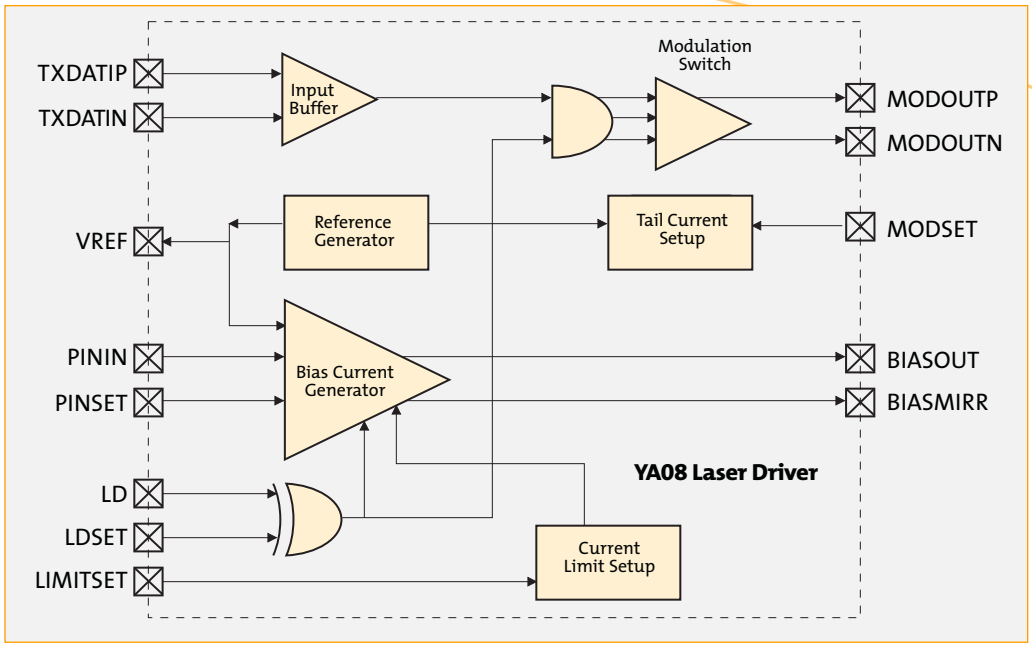


Figure 2: Functional Block Diagram

Absolute Maximum Ratings

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of, the device. Avoid operating the device outside the recommended operating conditions defined below.

Symbol	Parameter	Min	Max	Unit
VCC	Supply voltage – any VCC pin	-0.7	6.0	V
VI	Single ended input voltage – CML/PECL & CMOS inputs	-0.7	6.0	V
VIdiff	Peak differential voltage – CML/PECL inputs	-1.3	1.3	V
VIsetm	MODSET/LIMITSET pins - maximum applied voltage	-0.7	2.2	V
VIsetb	PINSET/PININ pins - maximum applied voltage	-0.7	VCC +0.7	V
Iomodout	Output current – MODOUTP/N outputs	-2	120	mA
Iobiasout	Output current - BIASOUT output	-2	130	mA
Iisetm	MODSET/LIMITSET - maximum source/sink current	-5	5	mA
Iisetb	PINSET PININ pins - maximum source/sink current	-7	7	mA
Iovref	VREF output current	-15	15	mA
Tstg	Storage temperature	-65	150	°C

Note: by convention, positive current values flow into pins, negative values flow out.

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VCC	Supply voltage – any VCC pin	4.7	5.0	5.3	V
Vicml	CML/PECL input voltage – single ended wrt GND	VCC -2.5		VCC +0.2	V
VIDcml	CML/PECL input voltage – differential	0.4		1.0	V
VIHcmos	CMOS compatible input HIGH voltage	2.0		VCC +0.5	V
VILcmos	CMOS compatible input LOW voltage	-0.5		0.8	V
Iisetm	MODSET/LIMITSET pins - source current			3	mA
IOVREF	VREF pin - source current			10	mA
IPININ	Current at pins PINSET and PININ	-5		5	mA
VBIASOUT	Permissible voltage range at BIASOUT pin	1.2		4	V
Tamb	Operating ambient temperature	-40		85	°C

DC Electrical Characteristics

Over recommended operating conditions, output load 25 Ω.

Symbol	Parameter	Min	Typ	Max	Unit
IIHcmos	CMOS Compatible Input HIGH current			180	µA
IILcmos	CMOS Compatible Input LOW current			-30	µA
IBIASOUT	Output current setting range – BIASOUT pin	5		100	mA
IBIASleak	BIASOUT pin - Output current in shutdown state			1	µA
VPINSET	Bias voltage at PINSET pin	1.20		1.32	V
VPINSETppm	Temperature coefficient of voltage at PINSET pin	-200		200	ppm/°C
VLIMSET	Bias voltage at LIMSET pin	1.20		1.33	V
VLIMSETppm	Temperature coefficient of voltage on LIMSET pin	-200		200	ppm/°C
ILIMIT	Bias current limiter setting range	5		100	mA
	Ratio of BIASOUT current to BIASMIRR current.	11	12	13	

DC Electrical Characteristics (continued)

Over recommended operating conditions, output load 25 Ω.

Symbol	Parameter	Min	Typ	Max	Unit
IMODOUT	Output current setting range – MODOUTP/N pins	10		80	mA
VMODSET	Bias voltage at MODSET pin	1.20		1.32	V
VMODSETppm	Temperature coefficient of voltage at MODSET pin	-200		200	ppm/°C
VMODOUTN	Voltage compliance at MODOUTN pin	1.4		4.0	V
VMODOUTP	Voltage compliance at MODOUTP pin	2.4		5.3	V
Ileakm	MODOUTN Output leakage. (NOTE 1)			100	µA
Pd0	Power dissipation (Ibiasout, Imodout = 0)			350	mW
Pdwkg	Power dissipation (IBIASOUT = 60 mA, IMODOUT = 25 mA, Vbias = Vmod = 2.5 V)			700	mW
PDmax	Maximum power dissipation (IBIASOUT = max, IMODOUT = max, Vbias = Vmod = 2.5 V)			1.2	W

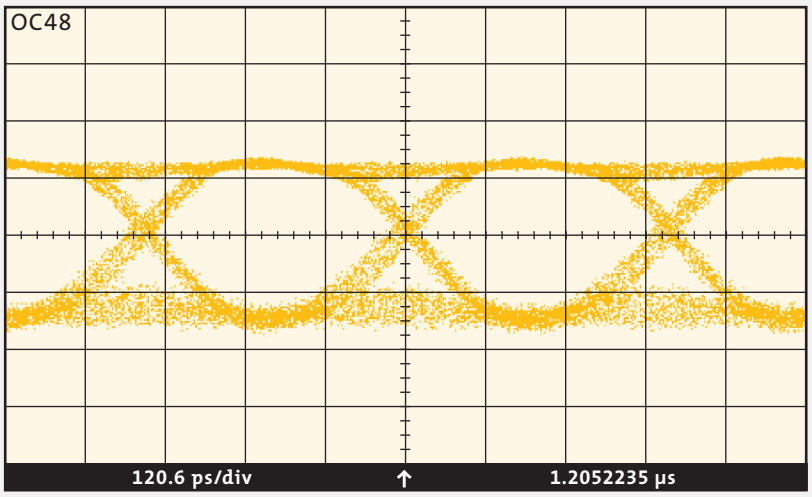
NOTE 1 - Measured with 3.0 V source applied between MODOUTN and Ground, an input voltage differential (TXDATIP wrt TXDATIN) of 400 mV, and applicable for all values of modulation current.

AC Characteristics

Over recommended operating conditions, output load 25 Ω.

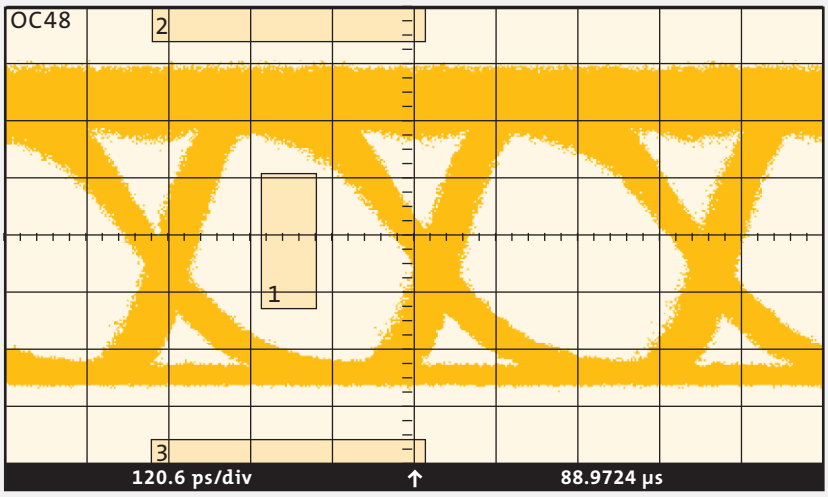
Symbol	Parameter	Min	Max	Unit
DRi	Input data rate		2600	Mb/s
trMODOUT	Rise time MODOUTP/N output	30	150	ps
tfMODOUT	Fall time MODOUTP/N output	30	150	ps
RMSmodout	Output data mark/space ration MODOUTP/N	48	52	%

Typical Operating Characteristics



Scale: 50.0 mV/div

Figure 3: Electrical data eye at Imodout = 60 mA



Scale: 100 µW/div **Offset:** 148.4 µW

Figure 4: Optical data eye at 25° C (MiniDIL Fabry-Perot laser)

Design Procedure and Applications Information

The application diagram in Figure 5 shows a typical configuration for the use of the YA08 in a 2.5 Gb/s OC- 48/STM-16 system. This shows all required external components, including supply decoupling capacitors, with values chosen to provide the following performance characteristics when used with a Nortel Networks NTW103AE laser diode.

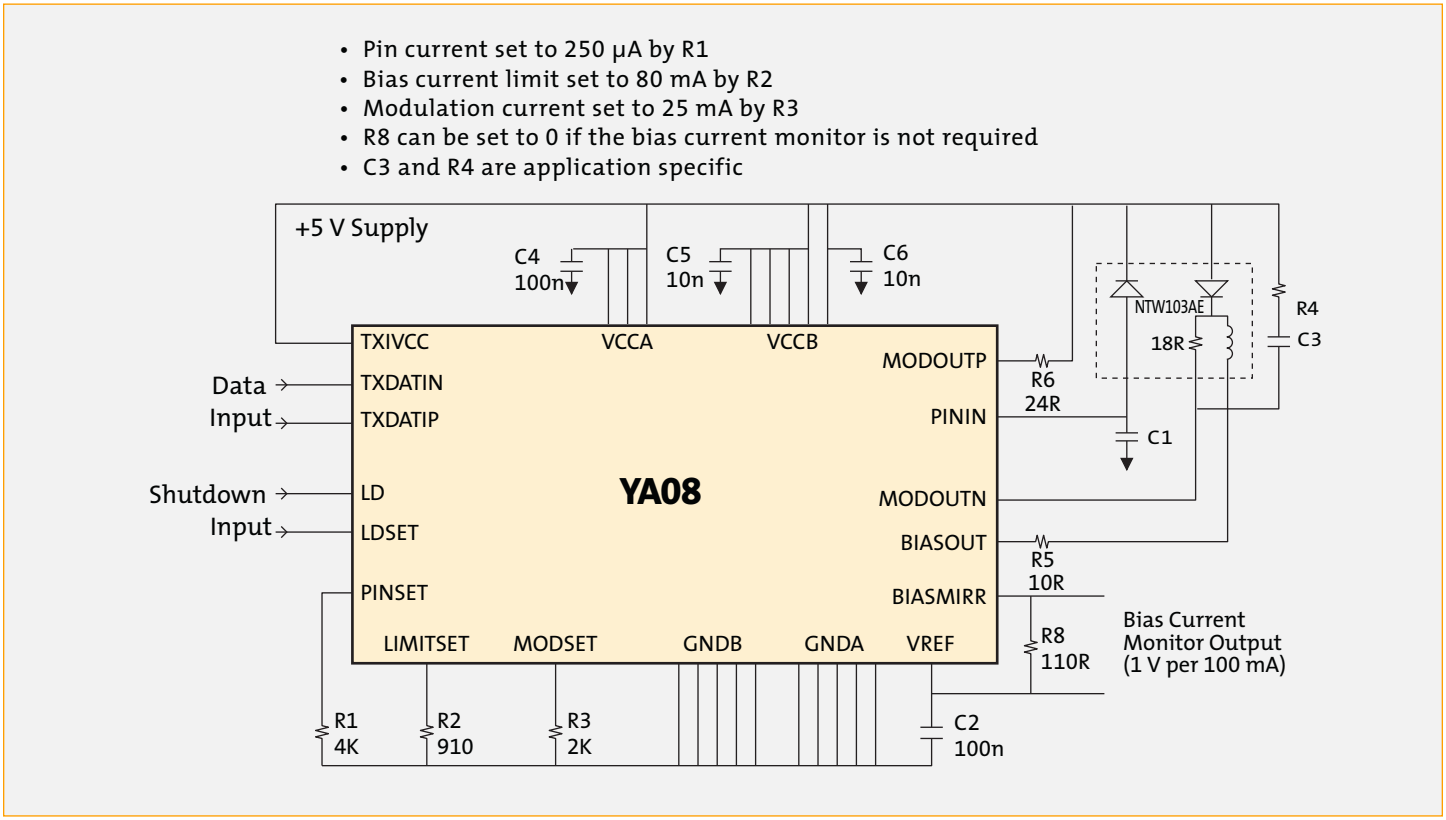


Figure 5: Typical Application Information

Modulation Current Driver

The modulation switch consists of a differential common emitter stage with outputs on the MODOUTP and MODOUTN pins and with tail current defined by an external resistor connected between the MODSET pin and GND (R3 in Figure 5). The tail current is switched either to MODOUTP or MODOUTN depending on the state of the data at the TXDATIP/N inputs. With the laser diode cathode connected to the MODOUTN output, a positive input voltage on TXDATIP with respect to TXDATIN will turn on the laser diode. A logic gate at the input to the switch allows current to be directed just to the MODOUTP pin for laser shutdown. The MODOUTP pin is connected to VCC via a suitable damping resistor, R6.

The external resistor RMODSET (R3) has a temperature stabilised voltage applied across it from the MODSET pin. This allows current in an internal resistor to be determined accurately, independent of temperature. This current is mirrored to the tail current of the modulation switch with a ratio of 40. The tail current in the modulation switch, Imod, is determined by:

$$\mathbf{Imod = 40 \times (1.2\ V/R_{MODSET})}$$

or the value of RMODSET (R3) is defined by:

$$\mathbf{R3 = 48/Imod}$$

Mean Power Controller

Figure 6 shows the Mean Power Controller block diagram.

The mean power control loop senses the output from a back-facet monitor diode and controls the laser bias current. The bias current can be set to any value between 1 mA (start of life) and 100 mA (end of life) with a single external resistor, RPINSET (R1).

$$R_{PINSET} = 1.26/Ipin$$

The control loop action is to feed the monitor diode current through an on chip current source and compare the voltage at PININ with an internally generated bandgap reference. The loop drives the voltage at PININ to be equal to the reference.

A current limiting circuit in the bias current generator prevents the output current exceeding a preset threshold, irrespective of the monitor diode current.

The current at which limiting commences is programmed by means of an external resistor (R2) connected between the LIMITSET pin and GND.

$$72/R_{LIMITSET} < Ibias\_max < 80/R_{LIMITSET}$$

The above takes account of the variation of VLIMSET from 1.2 V to 1.33 V.

The BIASMIRR pin provides a means of monitoring the laser bias current externally. A current proportional to the bias current is sunk by this pin, which would normally be externally terminated to either VCC or VREF via a suitable resistor. However if the monitoring function is not required this pin may be shorted to the VREF pin. The ratio between bias current and BIASMIRR current is set internally to 11.

C1 determines the time constant of the bias control loop such that:

$$T = C1 / 0.25K, \text{ where K is } \Delta I_f/\Delta I_{bfm}.$$

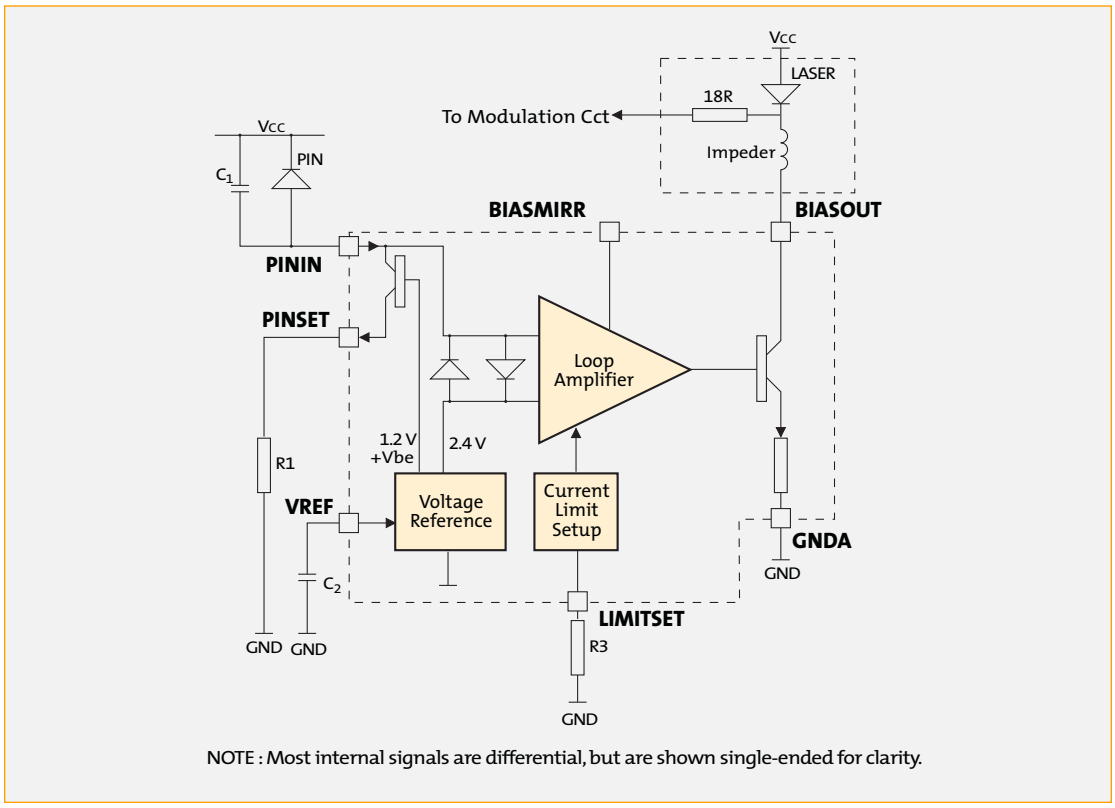


Figure 6: Mean Power Controller Block Diagram

Pin Assignment

Pin No	Symbol	Type	Description	Function
1, 2	GNDA	P		High current ground
3	PININ	I	Analog	Connection for monitor diode anode
4, 5, 7	GNDB	P		'Quiet' ground
6	PINSET	I	Analog	Connection for monitor diode current setting resistor
8	VCCB	P		'Quiet' power supply
9	GNDB	P		'Quiet' ground
10	TXDATIP	I	CML	Data input +ve
11	TXIVCC	I		Positive connection for data input termination resistors
12	TXDATIN	I	CML	Data input –ve
13	GNDB	P		'Quiet' ground
14, 15	VCCB	P		'Quiet' power supply
16	SD	I	CMOS	Shutdown input. CMOS compatible
17	SDSET	I	CMOS	Shutdown configure input. CMOS compatible
18	VCCB	P		'Quiet' power supply
19	GNDB	P		'Quiet' ground
20	LIMITSET	I	Analog	Connection for bias current limit setting resistor
21	BIASMIRR	O	Analog	Bias current mirror output
22	VREF	O	Analog	2.4 V bandgap reference output
23	MODSET	I	Analog	Connection for modulation current setting resistor
24	BIASOUT	O	Analog	Bias current output pin
25, 27, 29	GNDA	P		High current Ground
26	MODOUTN	O	Analog	Modulation output -ve pin. connection for laser diode cathode
28	MODOUTP	O	Analog	Modulation output +ve pin.
30, 31, 32	VCCA	P		High current power supply

Package Pin Configuration

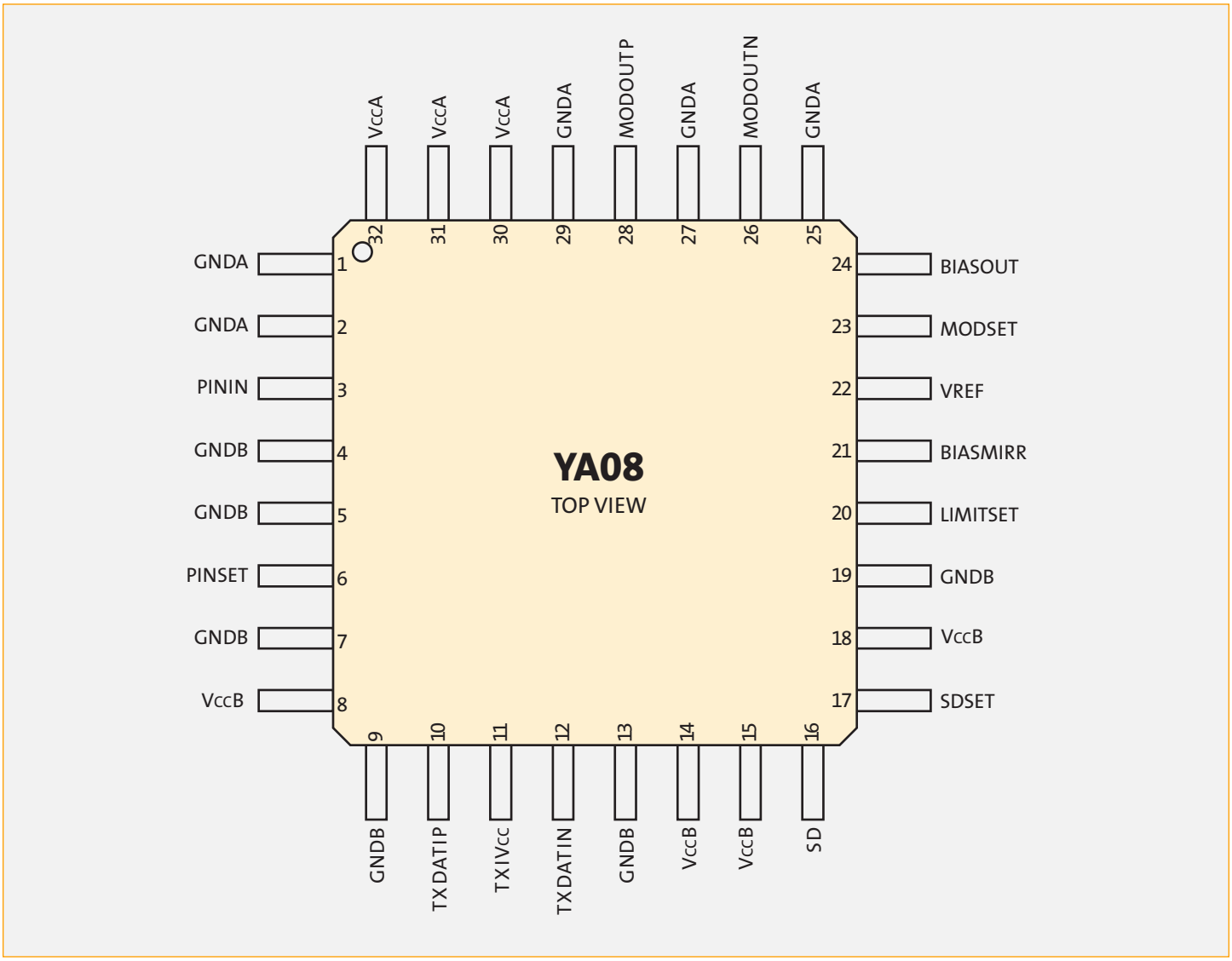


Figure 7: Package Pin Configuration

Package Outline Drawing and Dimensions

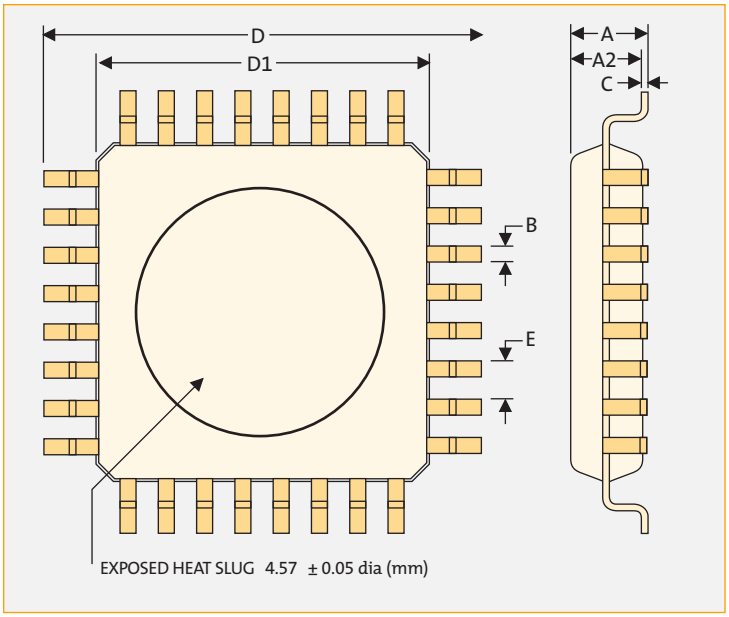


Figure 8: Package Outline

Dimension	Nominal	Tol	Units
D	9	± 0.20	mm
D1	7	± 0.10	mm
B	0.35	± 0.05	mm
E	0.80		mm
A	1.6	MAX	mm
A2	1.4	± 0.05	mm
C	0.05 (min)	0.15 (max)	mm

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