

### FEATURES

- 3.3V and 5V power supply options
- Up to 2.5Gbps operation
- Low noise
- Chatter-free signal detect (SD) generation
- Open collector TTL signal detect (SD) output
- TTL EN input
- Differential PECL inputs for data
- Single power supply
- Designed for use with Micrel-Synergy laser diode driver and controller
- Available in a tiny (3mm) 10-pin MSOP

### APPLICATIONS

- 1.25Gbps and 2.5Gbps ethernet
- 531Mbps, 1062Mbps and 2.12Gbps Fibre Channel
- 622Mbps SONET
- Gigabit interface converter
- 2.5Gbps SDH/SONET
- 2.5Gbps proprietary links

### DESCRIPTION

The SY88943V limiting post amplifier with its high gain and wide bandwidth is ideal for use as a post amplifier in fiber-optic receivers with data rates up to 2.5Gbps. Signals as small as 5mVp-p can be amplified to drive devices with PECL inputs. The SY88943V generates a chatter-free Signal Detect (SD) open collector TTL output.

The SY88943V incorporates a programmable level detect function to identify when the input signal has been lost. The SD output will change from logic "HIGH" to logic "LOW" when input signal is smaller than the swing set by  $SD_{LVL}$ . This information can be fed back to the EN input of the device to maintain stability under loss of signal condition. Using  $SD_{LVL}$  pin, the sensitivity of the level detection can be adjusted. The  $SD_{LVL}$  voltage can be set by connecting a resistor divider between  $V_{CC}$  and  $V_{REF}$  as shown in Figure 3. Figure 4, 5, 6, and 7 show the relationship between input level sensitivity and the voltage set on  $SD_{LVL}$ .

The SD output is a TTL open collector output that requires a pull-up resistor for proper operation, Figure 1.

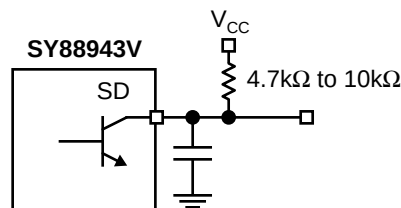
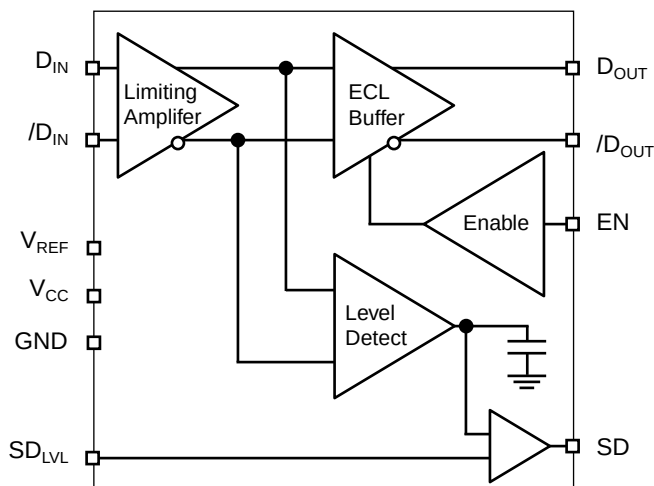
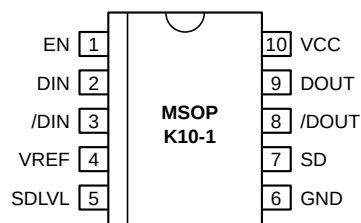


Figure 1. SD Output with Desired Rise Time

### BLOCK DIAGRAM



## PACKAGE/ORDERING INFORMATION



## Ordering Information

| Part Number                 | Package Type | Operating Range | Package Marking                      | Lead Finish    |
|-----------------------------|--------------|-----------------|--------------------------------------|----------------|
| SY88943VKC                  | K10-1        | Commercial      | 943V                                 | Sn-Pb          |
| SY88943VKCTR <sup>(1)</sup> | K10-1        | Commercial      | 943V                                 | Sn-Pb          |
| SY88943VKG                  | K10-1        | Commercial      | 943V with Pb-Free bar-line indicator | Pb-Free NiPdAu |
| SY88943VKGTR <sup>(1)</sup> | K10-1        | Commercial      | 943V with Pb-Free bar-line indicator | Pb-Free NiPdAu |

**Note:**

1. Tape and Reel.

## PIN NAMES

| Pin               | Type                        | Function                                               |
|-------------------|-----------------------------|--------------------------------------------------------|
| D <sub>IN</sub>   | Data Input                  | Data Input                                             |
| /D <sub>IN</sub>  | Data Input                  | Inverting Data Input                                   |
| SD <sub>LVL</sub> | Input                       | SD Level Set                                           |
| EN                | TTL Input                   | Output Enable (Active High)                            |
| SD                | TTL Output (Open Collector) | Signal Detect                                          |
| GND               | Ground                      | Ground                                                 |
| /D <sub>OUT</sub> | PECL Output                 | Inverting Data Output                                  |
| D <sub>OUT</sub>  | PECL Output                 | Data Output                                            |
| V <sub>CC</sub>   | Power Supply                | Positive Power Supply                                  |
| V <sub>REF</sub>  | Output                      | Reference Voltage Output for SD Level Set (see Fig. 3) |

## GENERAL DESCRIPTION

### General

The SY88943V is an integrated limiting amplifier intended for high-frequency fiber-optic applications. The circuit connects to typical transimpedance amplifiers found within a fiber-optics link. The linear signal output from a transimpedance amplifier can contain significant amounts of noise, and may vary in amplitude over time. The SY88943V limiting amplifier quantizes the signal and outputs a voltage-limited waveform.

The EN pin allows the user to disable the output signal without removing the input signal.

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                               | Rating                         | Value                                        | Unit |
|--------------------------------------|--------------------------------|----------------------------------------------|------|
| V <sub>CC</sub>                      | Power Supply Voltage           | 0 to +7.0                                    | V    |
| D <sub>IN</sub> , /D <sub>IN</sub>   | Input Voltage                  | 0 to V <sub>CC</sub>                         | V    |
| D <sub>OUT</sub> , /D <sub>OUT</sub> | Output Voltage (with 50Ω load) | V <sub>CC</sub> -2.5 to V <sub>CC</sub> +0.3 | V    |
| EN                                   | Input Voltage                  | 0 to V <sub>CC</sub>                         | V    |
| SD <sub>LVL</sub>                    | Input Voltage                  | 0 to V <sub>CC</sub>                         | V    |
| V <sub>REF</sub>                     | Output Voltage                 | V <sub>CC</sub> -2.0 to V <sub>CC</sub>      | V    |
| T <sub>A</sub>                       | Operating Temperature Range    | -40 to +85                                   | °C   |
| T <sub>store</sub>                   | Storage Temperature Range      | -55 to +125                                  | °C   |

**Note:**

1. Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**DC ELECTRICAL CHARACTERISTICS**
 $V_{CC} = +5V \pm 10\%$ ,  $R_{LOAD} = 50\Omega$  to  $V_{CC} - 2V$ 

| Symbol       | Parameter                                         | $T_A = -40^\circ C$ |                                         | $T_A = 0^\circ C$   |                                         | $T_A = +25^\circ C$ |                 |                                         | $T_A = +85^\circ C$ |                                         | Unit    |
|--------------|---------------------------------------------------|---------------------|-----------------------------------------|---------------------|-----------------------------------------|---------------------|-----------------|-----------------------------------------|---------------------|-----------------------------------------|---------|
|              |                                                   | Min.                | Max.                                    | Min.                | Max.                                    | Min.                | Typ.            | Max.                                    | Min.                | Max.                                    |         |
| $I_{CC}$     | Power Supply Current <sup>(1)</sup><br>5V<br>3.3V | —                   | 40                                      | —                   | 40                                      | —                   | 33              | 40                                      | —                   | 45                                      | mA      |
| $I_{IL}$     | EN Input LOW Current                              | -0.3 <sup>(6)</sup> | —                                       | -0.3 <sup>(6)</sup> | —                                       | -0.3 <sup>(6)</sup> | —               | —                                       | -0.3 <sup>(6)</sup> | —                                       | mA      |
| $I_{IH}$     | EN Input HIGH Current                             | —                   | 20 <sup>(4)</sup><br>100 <sup>(5)</sup> | —                   | 20 <sup>(4)</sup><br>100 <sup>(5)</sup> | —                   | —               | 20 <sup>(4)</sup><br>100 <sup>(5)</sup> | —                   | 20 <sup>(4)</sup><br>100 <sup>(5)</sup> | $\mu A$ |
| $V_{CMR}$    | Common Mode Range                                 | GND +2.0            | $V_{CC}$                                | GND +2.0            | $V_{CC}$                                | GND +2.0            | —               | $V_{CC}$                                | GND +2.0            | $V_{CC}$                                | V       |
| $V_{offset}$ | Differential Output Offset                        | —                   | $\pm 100$                               | —                   | $\pm 100$                               | —                   | $\pm 17$        | $\pm 100$                               | —                   | $\pm 100$                               | mV      |
| $SD_{LVL}$   | $SD_{LVL}$ Level                                  | $V_{REF}$           | $V_{CC}$                                | $V_{REF}$           | $V_{CC}$                                | $V_{REF}$           | —               | $V_{CC}$                                | $V_{REF}$           | $V_{CC}$                                | V       |
| $V_{OL}$     | SD Output Low Level <sup>(2)</sup>                | —                   | 0.5                                     | —                   | 0.5                                     | —                   | —               | 0.5                                     | —                   | 0.5                                     | V       |
| $I_{OH}$     | SD Output Leakage <sup>(3)</sup>                  | —                   | 100                                     | —                   | 100                                     | —                   | —               | 100                                     | —                   | 100                                     | $\mu A$ |
| $V_{OH}$     | $D_{OUT}$ and $/D_{OUT}$ HIGH Output              | $V_{CC} - 1085$     | $V_{CC} - 880$                          | $V_{CC} - 1025$     | $V_{CC} - 880$                          | $V_{CC} - 1025$     | $V_{CC} - 955$  | $V_{CC} - 880$                          | $V_{CC} - 1025$     | $V_{CC} - 880$                          | mV      |
| $V_{OL}$     | $D_{OUT}$ and $/D_{OUT}$ LOW Output               | $V_{CC} - 1830$     | $V_{CC} - 1555$                         | $V_{CC} - 1810$     | $V_{CC} - 1620$                         | $V_{CC} - 1810$     | $V_{CC} - 1705$ | $V_{CC} - 1620$                         | $V_{CC} - 1810$     | $V_{CC} - 1620$                         | mV      |
| $V_{REF}$    | Reference Supply                                  | $V_{CC} - 1.38$     | $V_{CC} - 1.26$                         | $V_{CC} - 1.38$     | $V_{CC} - 1.26$                         | $V_{CC} - 1.38$     | $V_{CC} - 1.32$ | $V_{CC} - 1.26$                         | $V_{CC} - 1.38$     | $V_{CC} - 1.26$                         | V       |
| $I_{REF}$    | $V_{REF}$ Output Current                          | -0.8                | 0.5                                     | -0.8                | 0.5                                     | -0.8                | —               | 0.5                                     | -0.8                | 0.5                                     | mA      |
| $V_{IH}$     | EN Input HIGH Voltage                             | 2.0                 | —                                       | 2.0                 | —                                       | 2.0                 | —               | —                                       | 2.0                 | —                                       | V       |
| $V_{IL}$     | EN Input LOW Voltage                              | —                   | 0.8                                     | —                   | 0.8                                     | —                   | —               | 0.8                                     | —                   | 0.8                                     | V       |

**Notes:**

1. No output load
2.  $I_{OL} = +2mA$
3.  $V_{OH} = 5.5V$

4.  $V_{IN} = 2.7V$ 5.  $V_{IN} = V_{CC}$ 6.  $V_{IN} = 0.5V$ **AC ELECTRICAL CHARACTERISTICS**
 $V_{CC} = +5V \pm 10\%$ ,  $R_{LOAD} = 50\Omega$  to  $V_{CC} - 2V$ 

| Symbol     | Parameter                                        | $T_A = -40^\circ C$ |      | $T_A = 0^\circ C$ |      | $T_A = +25^\circ C$ |                           |      | $T_A = +85^\circ C$ |      | Unit             | Conditions                                     |
|------------|--------------------------------------------------|---------------------|------|-------------------|------|---------------------|---------------------------|------|---------------------|------|------------------|------------------------------------------------|
|            |                                                  | Min.                | Max. | Min.              | Max. | Min.                | Typ.                      | Max. | Min.                | Max. |                  |                                                |
| PSRR       | Power Supply <sup>(1)</sup> Rejection Ratio      | —                   | —    | —                 | —    | —                   | 35                        | —    | —                   | —    | dB               | Input referred, 55MHz                          |
| $V_{ID}$   | Input Voltage Range                              | 5                   | 1800 | 5                 | 1800 | 5                   | —                         | 1800 | 5                   | 1800 | mV <sub>PP</sub> |                                                |
| $V_{OD}$   | Differential Output Voltage Swing <sup>(2)</sup> | —                   | —    | —                 | —    | —                   | 700<br>300                | —    | —                   | —    | mV<br>mV         | $V_{ID} = 15mV_{PP}$<br>$V_{ID} = 5mV_{PP}$    |
| $t_{ONL}$  | SD Release Time <sup>(3)</sup> Minimum Input     | —                   | 0.5  | —                 | 0.5  | —                   | 0.2                       | 0.5  | —                   | 0.5  | $\mu s$          |                                                |
| $t_{ONH}$  | SD Release Time <sup>(4)</sup> Maximum Input     | —                   | 0.5  | —                 | 0.5  | —                   | 0.2                       | 0.5  | —                   | 0.5  | $\mu s$          |                                                |
| $t_{OFFL}$ | SD Assert Time <sup>(3)</sup>                    | —                   | 0.5  | —                 | 0.5  | —                   | 0.1                       | 0.5  | —                   | 0.5  | $\mu s$          |                                                |
| $V_{SR}$   | SD Sensitivity Range                             | 5                   | 50   | 5                 | 50   | 5                   | —                         | 50   | 5                   | 50   | mV <sub>PP</sub> | 2 <sup>23</sup> -1 pattern                     |
| HYS        | SD Hysteresis                                    | 2                   | 8    | 2                 | 8    | 2                   | 4.6                       | 8    | 2                   | 8    | dB               | 2 <sup>23</sup> -1 pattern                     |
| $t_r, t_f$ | Output Rise/Fall Time                            | —                   | 175  | —                 | 175  | —                   | 150<br>$t_{rin}, t_{fin}$ | 175  | —                   | 175  | ps               | $V_{ID} > 100mV_{PP}$<br>$V_{ID} < 100mV_{PP}$ |

**Notes:**

1. Input referred noise = RMS output noise/low frequency gain.
2. Input is a 622MHz square wave.

3. Input is a 200MHz square wave,  $t_r < 300ps$ ,  $8mV_{PP}$ .4. Input is a 200MHz square wave,  $t_r < 300ps$ ,  $1.8V_{PP}$ .

## DESIGN PROCEDURE

### Output Termination

The SY88943V outputs must be terminated with a  $50\Omega$  load to  $V_{CC} - 2V$  (or Thevenin equivalent).

### Layout and PCB Design

Since the SY88943V is a high-frequency component, performance can be largely determined by the board layout and design. A common problem with high-gain amplifiers is the feedback from the large swing outputs to the input via the power supply.

The SY88943V ground pin should be connected to the circuit board ground. Use multiple PCB vias close to the part to connect to ground. Avoid long, inductive runs which can degrade performance.

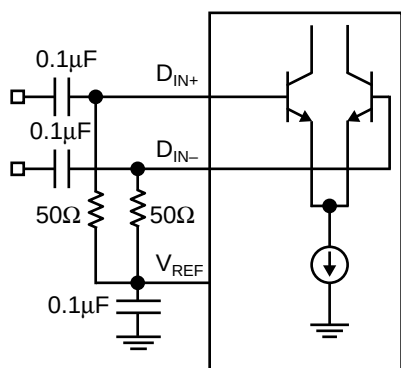


Figure 2. Differential Input Configuration

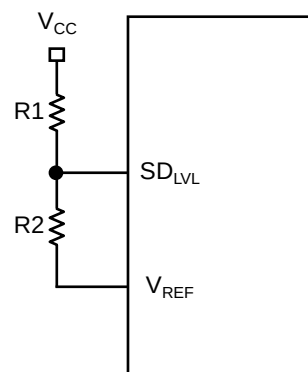


Figure 3.  $SD_{LVL}$  Circuit

#### Notes:

$$SD_{LVL} = V_{CC} - 1.32V + \frac{R2 \times 1.32V}{R1 + R2}$$

$$R1 + R2 \geq 2.6k\Omega$$

PERFORMANCE CURVE

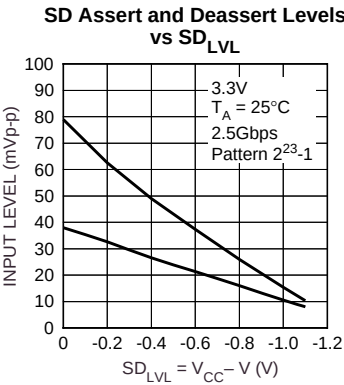


Figure 4.

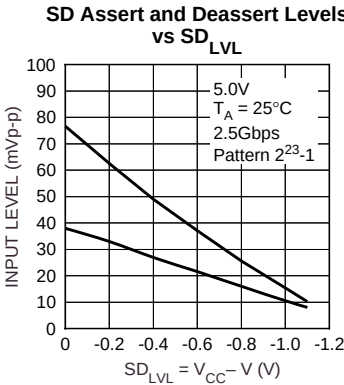


Figure 5.

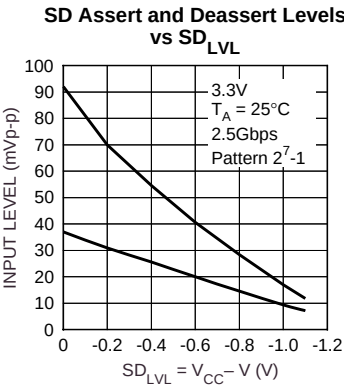


Figure 6.

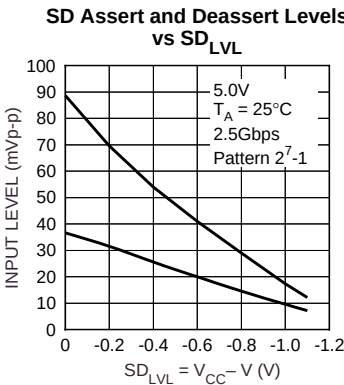
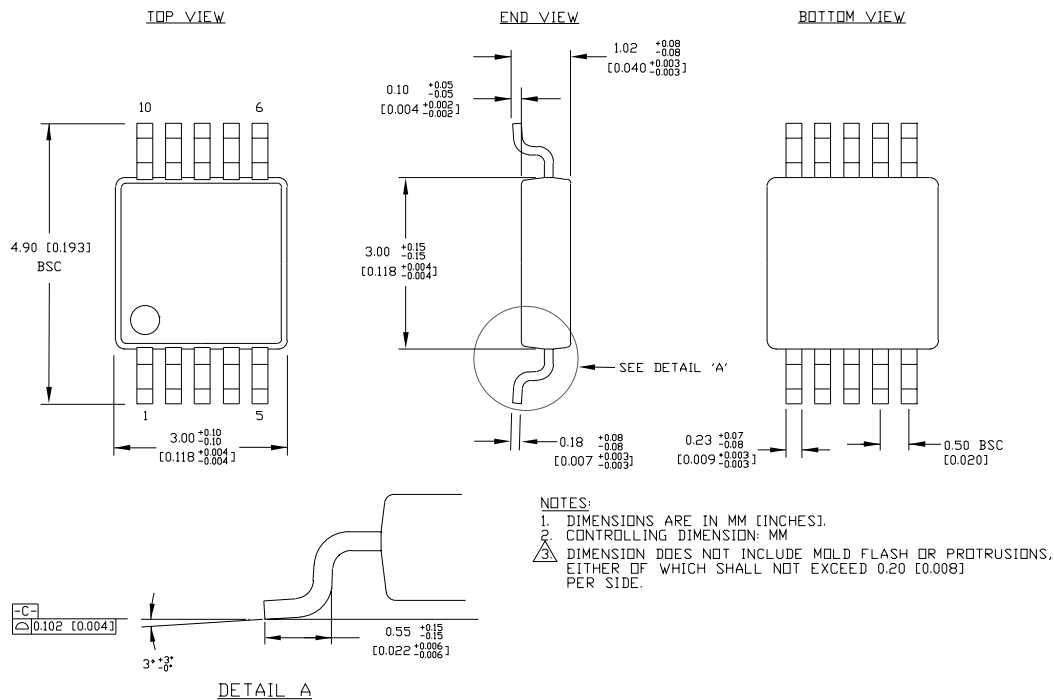


Figure 7.

# 10 LEAD MSOP (K10-1)



Rev. 00

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