SP9960

50M-BIT MANCHESTER BIPHASE-MARK ENCODER AND LED DRIVER

The SP9960 is a Manchester biphase-mark encoder and LED driver, designed for use in fibre-optic links at up to 50Mbits/s. It encodes TTL or ECL data and outputs the result as a current at either the large or small LED driver output. The LED driver and the current output are selected

The device is also available as the SP9960AC, which has guaranteed operation over the full Military Temperature Range and is screened to MIL-STD-883 Class B Data is available separately.

FEATURES

- -40°C to +85°C Operating Temperature Range
- 50Mbit/s Operation Clock and Data Rates
- TTL or ECL Inputs
- Choice of LED drivers - Large or Small
- Choice of LED Drive Currents
- LED Driver Enable Voltage
- Single Supply Voltage

APPLICATIONS

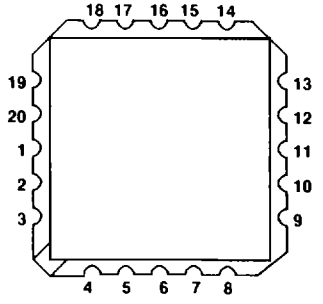
- Fibre Optic Data Link
- Local area Network (LAN) Interface
- Coaxial/Twisted Pair Devices

ORDERING INFORMATION

SP9960 B LC (Industrial - leadless chip carrier)
SP9960 AC LC (Military - leadless chip carrier, screened to MIL-STD-883C CLASS B)

ASSOCIATED PRODUCTS

SL9901 50MHz Transimpedance Amplifier
SP9921 50M-Bit Manchester Biphase Decoder



LC20

Pin	Function	Pin	Function	Pin	Function
1	NC	8	EDI	15	LD
2	V_{EE}	9	NC	16	NC
3	V_{EE}:10	10	V_{CC}	17	V_{EE}:80
4	TDI	11	DL	18	V_{EE}:45
5	TCI	12	DL	19	V_{EE}:LD
6	NC	13	SD	20	ODE
7	ECI	14	NC		

Fig.1 Pin connections - Top view

ABSOLUTE MAXIMUM RATINGS

Supply voltage	+ 7V
Input voltage	-3.0V to +0.3V
Storage temperature range	-65°C to +175°C
Maximum junction temperature	+175°C

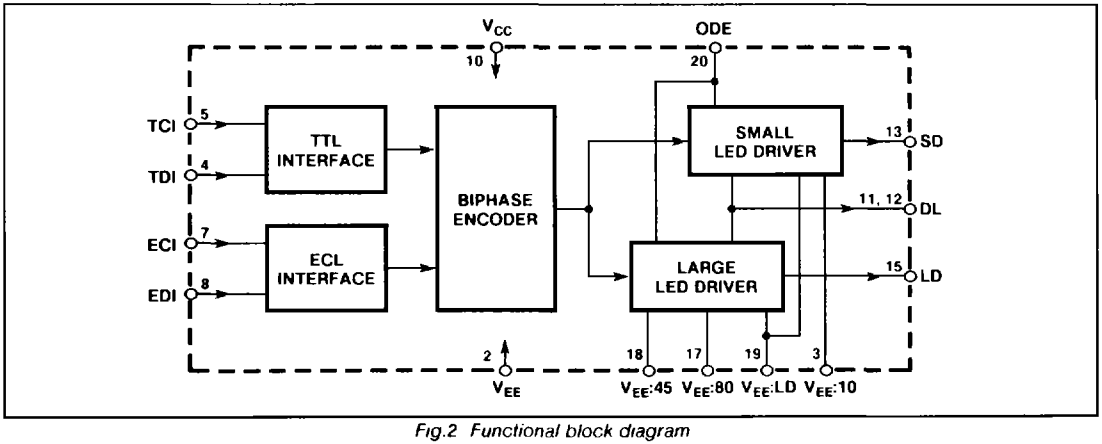


Fig.2 Functional block diagram

ELECTRICAL CHARACTERISTICS (Voltages are with respect to the negative power supply (V_{EE})

Test conditions (unless otherwise stated)

Supply voltage V_{CC} = +4.5V to +5.50V, T_{AMB} = -40°C to +85°C (see note 1).
Programming input low voltage V_{ODEL} = 0V to 0.4V, Programming input high voltage V_{ODEH} = 2V to V_{CC}; TTL input low voltage V_{ILT} = 0.84V Max; TTL input high voltage V_{ILT} = 2.0V min, ECL input low voltage $V_{ILE} = V_{CC}$ -1.65V max; ECL input high voltage $V_{IHE} = V_{CC}$ -0.96V min (see note 2).

Parameter	Symbol	Value		Units	Conditions
		Min	Max		
Supply current	I_{CC}		70	mA	Output disabled
TTL input current	I_T		130	µA	$V_{IHT} = V_{CC}$
ECL input current	I_E		300	µA	$V_{IHE} = V_{CC}$
Small driver ON current (sink) (note 3)	I_{SD}	12 20	18 30	mA mA	$1V < (V_{EE}:10) < V_{CC}$, default $V_{EE}:10 = V_{EE}$
Large driver ON current (sink) (note 3)	I_{LD}	35 72 102 140	55 108 148 200	mA mA mA mA	$1V < (V_{EE}:45/80) < V_{CC}$, default $V_{EE}:45 = V_{EE}$ $V_{EE}:80 = V_{EE}$ $V_{EE}:45 = V_{EE}$, $V_{EE}:80 = V_{EE}$
Operating clock frequency	f_C	50		MHz	

NOTES

1 The maximum temperature depends on the selected LED drive current. The limits are found by derating the limit of the chip temperature (given in Absolute Maximum Ratings) by the temperature difference due to the power dissipation and the thermal resistance to case or ambient (given in the Additional Information table)

2 T_{AMB} = +25C.

3. The maximum power dissipation depends on the selected output drive current It is always less than the product of the supply voltage and the sum of maximum drive current (either I_{SD} or I_{LD}) and the maximum current with driver disabled (I_{CC})

GUARANTEED CHARACTERISTICS

The following characteristics are guaranteed, but not tested, for the SP9960B at +25°C and over the full supply voltage range (+4.50V to +5.50V), refer to Figs. 5 to 7.

Parameter	Symbol	Value		Units	Conditions
		Min	Max		
Programming input (ODE) current low	I_{ODEL}		2.0	mA	V_{ODE} = 0V
Driver OFF leakage (sink)	I_L		100	µA	$0V < V_{ODE} < 0.4V$
Clock high period	t_{CH}	5		ns	
Clock low period	t_{CL}	5		ns	
Input data setup time	t_{IS}	5		ns	
Input data hold time	t_{IH}	0		ns	
Output data hold time	t_{OH}	0		ns	
Output data delay	t_{OD}		30	ns	
Output rise & fall time	t_{ORF}		2	ns	I_{LED} = 80mA, 10Ω to V_{CC}
1st half cycle period	$t1_{CP}$	t_{CL-2}		ns	
2nd half cycle period	$t2_{CP}$	t_{CL-2}		ns	

ADDITIONAL INFORMATION

The following parameters are typical for the SP9960 at +25°C but not tested

Characteristic	Symbol	Value	Units	Conditions
Thermal resistance, chip-to-case	θ_{CC}	28	°C/W	
Thermal resistance, chip-to-ambient	θ_{CA}	73	°C/W	
Pin capacitance	C_P	3	pF	Pin to supplies

FUNCTIONAL DESCRIPTION

Fig. 2 shows the simplified block diagram of the device. Data arriving at a data input (TDI or EDI pin) is sampled by the positive edge of the appropriate clock (TCI or ECI pin), encoded into a biphase-mark signal, and output as a current at the chosen LED driver (SD or LD pin)

If TTL inputs are to be used (TDI and TCI pins) then the ECL inputs (EDI and ECI) should be left unconnected and vice versa.

Biphase Mark Encoding

Fig. 3 shows how the biphase-mark encoding scheme works. The input data is sampled by the positive edge of the clock. If the data is high (logic '1') then the driver switches to its opposite state i.e., OFF if it was previously ON, or ON if it was previously OFF If the data is low (logic '0') then the driver does not switch to its opposite state on the positive clock edge.

Regardless of the sampled input data, the driver always switches to its opposite state on the negative edges of the clock.

This form of encoding ensures a high number of transitions in the signal which simplifies the task of clock recovery at a remote detector. Since the data is encoded in terms of transitions, rather than as absolute levels, the signal can be given a net inversion without corrupting the information carried.

LED Drivers

There are two LED driver outputs, the small driver (SD, pin 13) and the large driver (LD, pin 15). The driver used is chosen by V_{EE}:LD (pin 19) which should be tied to V_{EE} (pin 2) to select the large driver and left unconnected to select the small driver., as shown in Table 1.

Typical LED output currents for the small driver are 15mA or 25mA and for the large driver 45mA, 90mA, 125mA or 170mA, determined by the supply connections to the V_{EE}:10, V_{EE}:45 and V_{EE}:80 pins, as shown in Table 1.

When the LED driver is OFF then current is switched to the dummy load pins (DL) which are normally connected to the positive supply. This reduces the ringing which could otherwise occur on switching relatively large currents The drivers are disabled by pulling the ODE pin low. They are enabled if the ODE pin is left unconnected.

LED output selectors (ODE = O/C)				LED current (mA typ)	
V_{EE}:LD (19)	V_{EE}:10 (3)	V_{EE}:45 (18)	V_{EE}:80 (17)	SD (13)	LD (15)
O/C	O/C	X	X	15	-
O/C	V_{EE}	X	X	25	-
V_{EE}	X	O/C	O/C	-	45
V_{EE}	X	V_{EE}	O/C	-	90
V_{EE}	X	O/C	V_{EE}	-	125
V_{EE}	X	V_{EE}	V_{EE}	-	170

Table 1

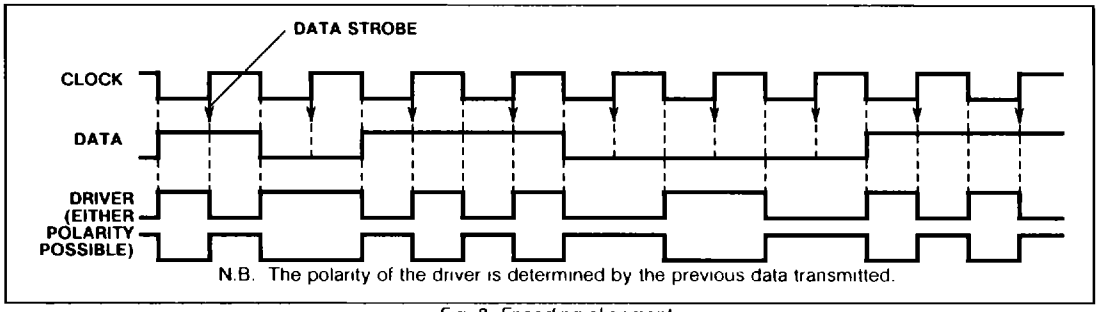


Fig. 3 Encoding alignment

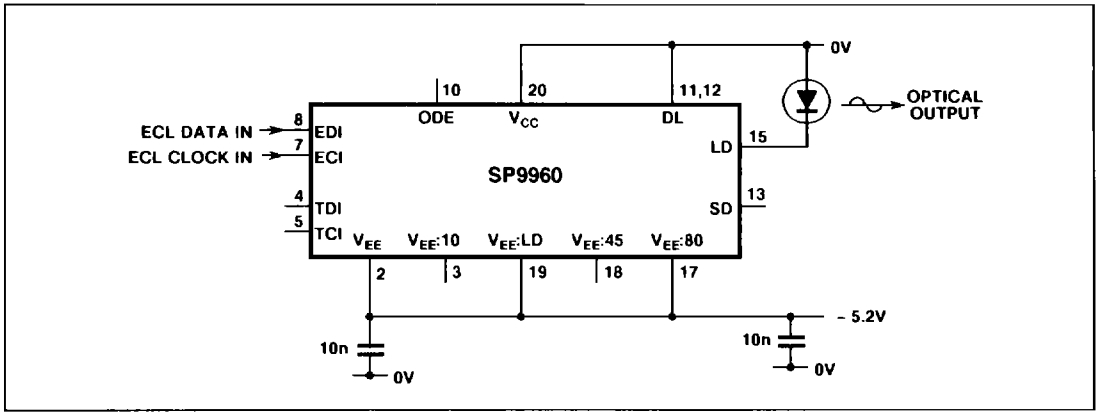


Fig. 4 Typical ECL application circuit - large driver at 125 mA (typical) selected

N.B. For TTL applications the TTL inputs TDI and TCI should be used, VCC should be + 5V and V_{EE} should be 0V.

PIN DESCRIPTIONS

Symbol	LCC Pin No	Pin Name and Description
V_{EE}	2	**Negative Supply (Power Input).** This pin is normally tied to 0V for TTL operation or to -5 2 V for ECL operation.
V_{EE}: 10	3	**10mA Negative Supply (Power Input).** This pin should be tied to the negative supply (VEE) to increase the current sink at the small current LED output driver (SD pin) by 10mA if the small driver is selected It should be left unconnected otherwise
TDI	4	**TTL Data Input (TTL Input with Internal Pull-Down).** TTL data is strobed in at this pin by the positive edges of the TTL Clock input (TCI pin). This pin should be left unconnected if the TTL inputs are not to be used See notes given in this table on V_{CC} and V_{EE}
TCI	5	**TTL Clock Input (TTL Input with Internal Pull-Down).** The rising edges of this clock is used to strobe the TTL data input (TTI pin) This pin should be left unconnected if the TTL inputs are not to be used See notes on V_{CC} and V_{EE}
ECI	7	**ECL Clock Input (ECL Input with Internal Pull-down).** The rising edge of this clock is used to strrobe the ECL data input (EDI pin) This pin should be left unconnected if the ECL inputs are not to be used. See notes on V_{CC} and V_{EE}
EDI	8	**ECL Data Input (ECL Input with Internal Pull-down).** ECL data is strobed in at this pin by the positive edges of the EC clock input (ECL pin) This should be left unconnected if the ECL inputs are not to be used See notes given in this table on V_{CC} and V_{EE}
V_{CC}	10	**Positive Supply (Power Input).** This pin is normally tied to 5V for TTL operation or to 0 V for ECL operation
DL	11,12	**Dummy Load (Current Sink Output).** Current is switched between these pins and the selected LED drivers (SD or LD) to reduce ringing They should be connected to the positive supply (V_{CC})
SD	13	***Small Driver (Current Sink Output).*** *This is the small current LED output driver* Data supplied at the clock and data pins is encoded and output as a current at this pin if the large driver negative supply pin (V_{EE} LD) is left unconnected
LD	15	**Large Driver (Current Sink Output).** This is the large current LED output driver. Data supplied at the clock and data pins is encoded and output as a current at this pin if the latge driver negative supply pin (V_{EE} LD) is tied to the negative supply (V_{EE}).
V_{EE}: 80	17	**80mA Negative Supply (Power Input).** This pin may be used in conjunction with the V_{EE} 45 pin. It should be tied to the negative supply (V_{EE}) to increase the current sink at the large current LED output driver (LD pin) by 80mA (typically) if the large driver is selected It should be left unconnected otherwise
V_{EE}: 45	18	**45mA Negative Supply (Power Input).** This pin may be used in conjunction with the V_{EE} 80 pin It should be tied to the negative supply (V_{EE}) to increase the current sink at the large current LED output driver (LD pin) by 45mA (typically) if the large driver is selected It should be left unconnected otherwise
V_{EE}: LD	19	**Large Driver Negative Supply (Power Input).** This pin should be tied to the negative supply (V_{EE}) if the large current LED output driver (LD pin) is to be used It should be left unconnected if the small current LED output driver (SD pin) is to be used
ODE	20	**Output Driver Enable (Programming Input with Internal Pull-up).** This pin should be left unconnected for normal operation. If it is low then the LED output driver is disabled

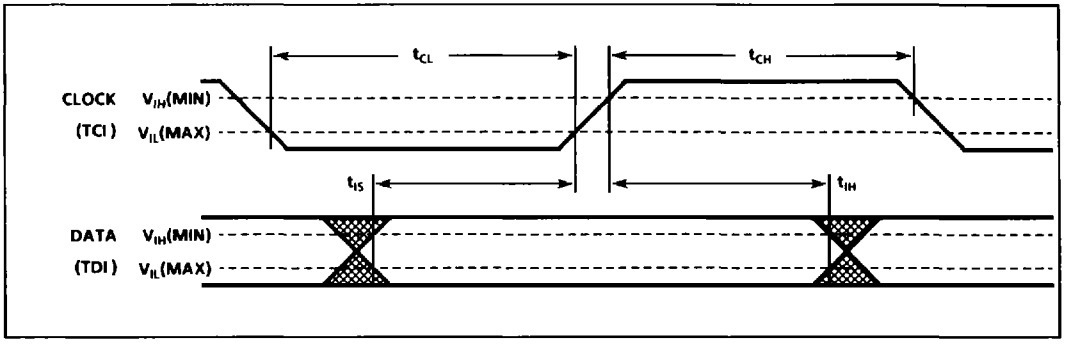


Fig. 5 Digital Switching Characteristics - TTL Input

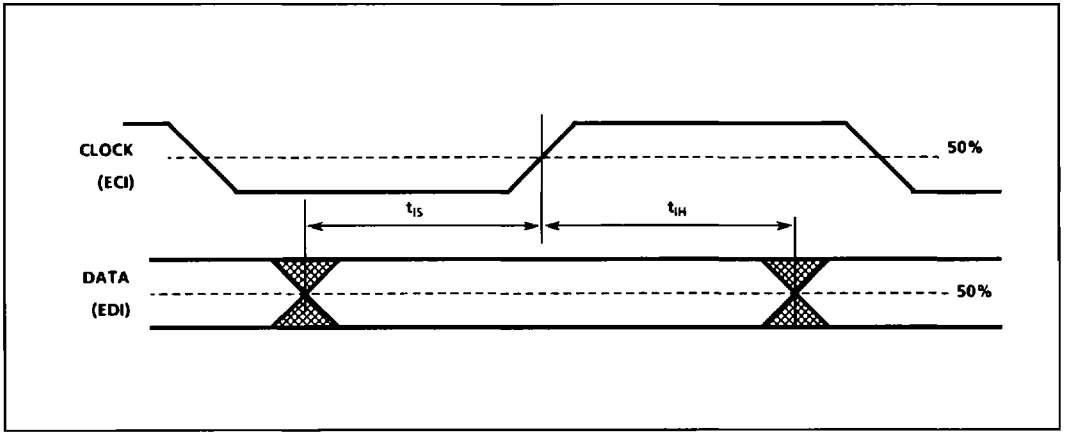


Fig. 6 Digital Switching Characteristics - ECL Input

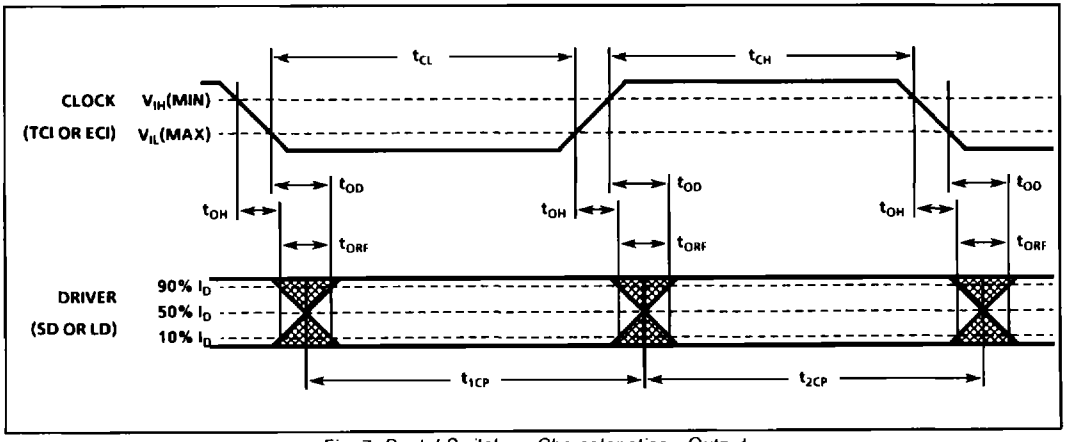


Fig. 7 Digital Switching Characteristics - Output