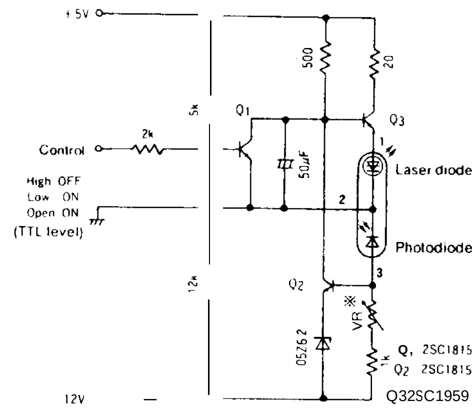
Drive Circuits

Typical Drive Circuits for M-Type Laser Diodes

The power output of a laser diode is easily changed by fluctuations in the ambient temperature, A drive circuit with an automatic power control (APC) function, acting as a feedback loop from the output of the monitor photodiode to the input of the laser diode, is normally used to maintain constant power output in an environment where temperature may vary. A typical circuit of this type is shown in Fig. 30-1 This circuit also features a slow start characteristic to eliminate power surges. The value of V_R should be selected according to the following table.

Fig.30-l Typical Drive Circuit



Model No.	VR Value	Model No.	VR Value
LT030 series, LT024AD LT022 series(9φ), LT023 series(9φ) LT026 series(9φ), LT010 series	25kΩ	LT021 series, LT027 series	5kΩ
LT022 series(5.6φ), LT023 series(5.6φ) LT026 series(5.6φ), LT011 series	60kΩ	LT024 MD LT015 series, LT025 MD LT017 series	20kΩ

※ Power Adjustment Instructions

1) Before turning the power on, set VR to its maximum value Turn the power on and then set the control input to low.
2) While monitoring the laser diode output with an optical power meter, gradually lower the VR value until the desired power output is obtained.

Note 1: Once the power level has been set, the laser diode can be turned on and off by using the control input (low/high) or by turning the power supply on and off. If the laser diode is replaced, repeal the procedure from step 1

Note 2: Do not connect or disconnect the laser diode while the power is on

●Circuits Using a Driver IC

Fig.30-2
•IR3C01/IR3C01 N

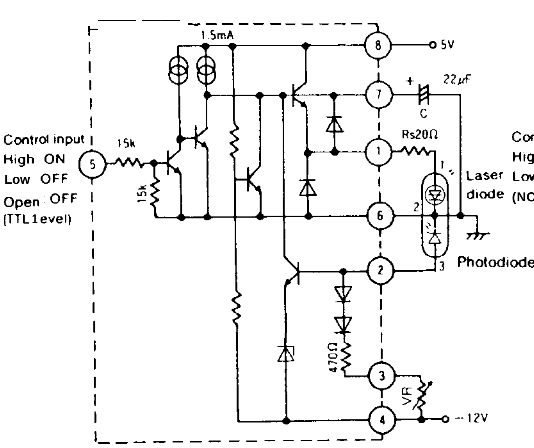
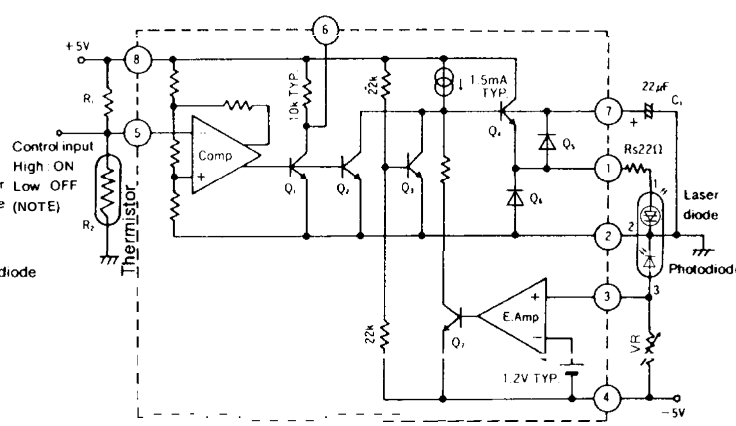


Fig. 30-3
. IR3C02A/IR3C02AN



Note If a thermal shut-off function is not required, remove R_1 and R_2, and use a TTL level input at Pin 5 to control the laser diode (high on, low off)

The value of VR should be selected according to the following table

Model No.	VR Value		Model No.	VR Value	
	IR3C01/IR3C01N	IR3C02A/IR3C02AN		IR3C01/IR3C01N	IR3C02A/IR3C02AN
LT030 series, LT024 AD LT022 series(9φ), LT023 series(9φ) LT026 series(9φ), LT010 series	15kΩ	5kΩ	LT021 series, LT027 series	3kΩ	1kΩ
			LT024 MD, LT015 series LT025 MD, LT017 series	100kΩ	30kΩ
LT022 series(5.6φ), LT023 series(5.6φ) LT026 series(5.6φ), LT011 series		15kΩ			

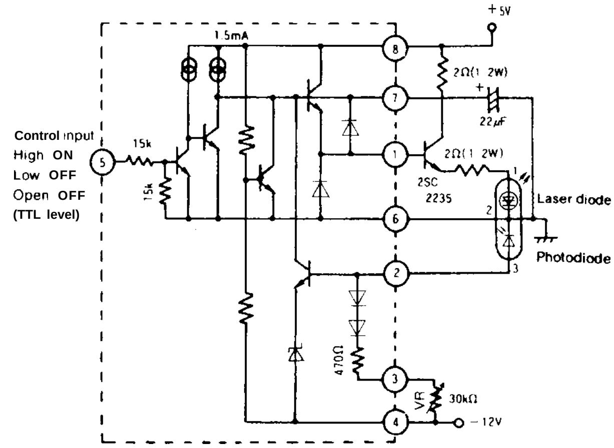
● Typical Drive Circuits for LT090MD/MF (Using Driver IC)

The operating current of LT090MD/MF is large, so-when driving it with driver IC IR3C01 or IR3C01 N, a transistor should be inserted between the output terminal of the IC and the laser diode as shown in Fig.31-1

Note See page 31 for power adjustment Instructlons Because of the high optical power output of LT090M0/MF, extreme care must be taken to prevent the direct vıewıng of the beam by human eyes

Fig.31 -1 Typical Drive Circuit for LT090 Series

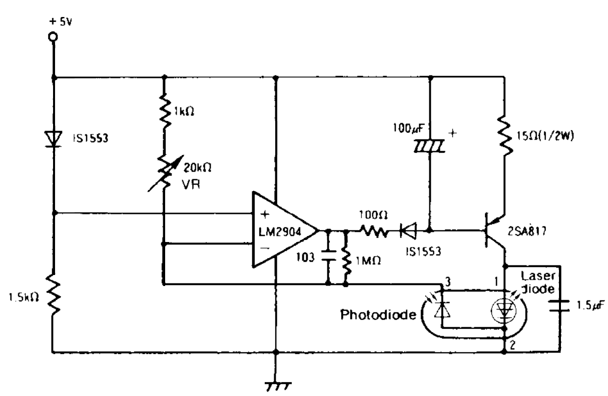
IR3C01 IR3C01 N



Typical Drive Circuits for P-type Laser Diodes

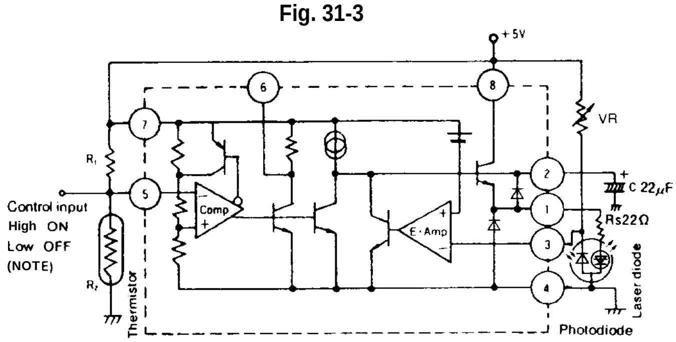
In the P-type laser diodes, the built-in PIN photodiode is reversed relative to Sharp's other models The same positive power voltage power supply that ıs used to drive the laser diode can be used to apply a reverse bias to the photodiode, as shown in Fig 31-2

Fig. 31 -2 Typical **Drive** Circuit for LT022PD **Series**



●Circuits Using a Driver IC

Fig. 31-3



IR3C07/IR3C07N

Note 1) See page 30 for power adjustment instructions and precautions.

2) If a thermal shut-off function ıs not required, remove R, and R_2 , and use a TTL level input at Pin 5 to control the laser diode (high on, low off)

The value of VR should be selected according to the following table

Model No.	VR Value
LT022PD, LT022WD LT024ED, LT028GS	15kΩ
LT022PS,LT022WS,LT023PS LT023WS, LTO1 1 PS, LT028PS	35kΩ
LT024PD, LT015PD, LT025PD	100kΩ

Pulse Drive Circuit

An important feature of laser diodes is their ability to respond to direct, high speed modulation.

In pulse drive operation, if the DC bias current, Ib, is less than the threshold current, Ith, a time delay will result between the drive current pulse and the optical power output pulse, Therefore, the DC bias current is normally set just above the threshold current to obtain quick response.

A typical drive circuit is shown in Fig. 32-2 The current flowing to the laser diode is used to obtain chopped pulse oscillation in a switching transistor.~he transistor used must have good high speed response. The DC bias current is adjusted by Rb.

In this circuit, the APC function uses the average optical power output. Therefore, even if the frequency of the optical power output pulse is the same, a change in the duty ratio will cause the maximum optical power output to change. Care must be taken to avoid exceeding the absolute maximum rated output of the laser diode.

When the APC does not readily function because the duty ratio of the desired optical power output is small (less than 1/1 O) and the average output is low, use a circuit such as that shown in Fig. 32-3.This circuit holds the peak monitor current and feeds it back, so that the APC will function regardless of the duty ratio of the optical power output. The operational amplifier used in the peak hold circuit must have quick response and a large input impedance Further, the time constant $t = RC$ of the peak hold circuit should be set sufficiently long in comparison with the drive pulse period f^{-1}.

The value of VR in the diagram should be selected according to the following table.

Model No.	VR Value
LT030 series, LT024 AD	
LT022 series, LT023 series(9φ)	15kΩ
LT026 series, LT01 O series	
LT022 series(5.6φ), LT023 series(5.6φ)	35kΩ
LT026 series(5.6φ), LTO1 1 series	
LT021 series, LT027 series	3kΩ
LT024 MD, LTO15 series	100kΩ
LTO17 series, LT025 MD	

In the case of pulse drive circuit shown in Fig 32-2, it is necessary to select the value of VR depending on the duty ratio.

Set the value of VR so that VR x duty ratio is equal to the value in the table. All Sharp laser diodes have a frequency response characteristic greater than 1 gigahertz and will more than meet the requirements of high speed optical communications (See Fig. 94-5)

Fig. 32-1 Principle of Direct Modulation

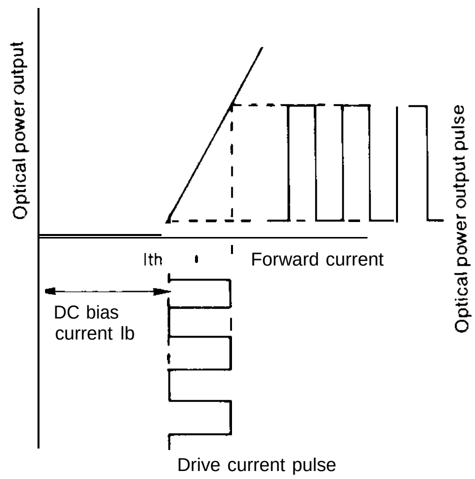
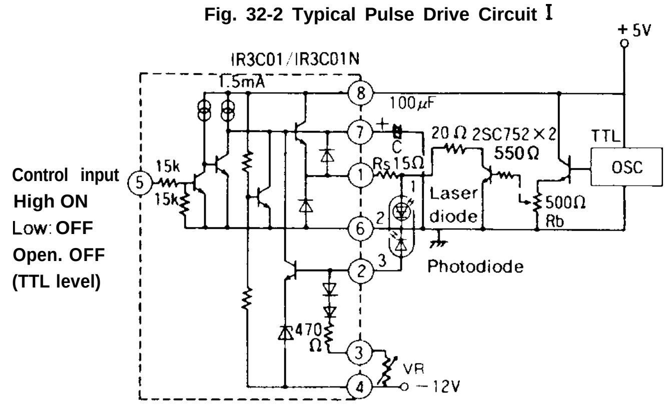
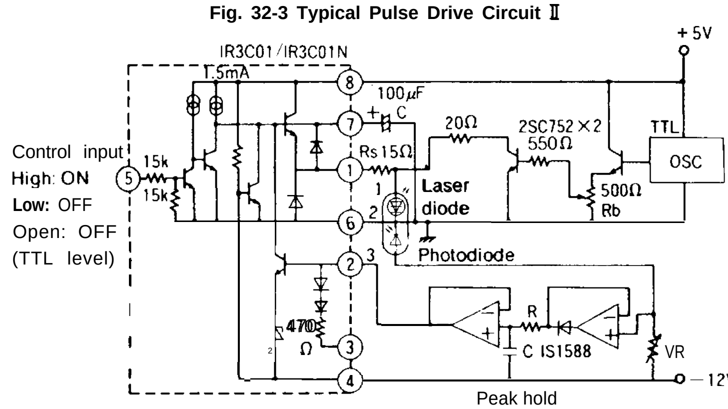


Fig. 32-2 Typical Pulse Drive Circuit I



Note: See page 30 for power adjustment instructions.

Fig. 32-3 Typical Pulse Drive Circuit II



OP amplifier: CA3240 (1/2) X 2

Note See page 31 for power adjustment instructions

● Pulse driver IC (IR3C08)

An example of a pulse drive circuit is illustrated on the previous page, Sharp has developed the IR3C08 pulse driver IC for easy use in laser printers.
The IR3C08 controls the operating current level so that the optical power output of the laser diode will be constant. In addition, it is capable of switching the laser beam on and off at extremely high speeds The IR3C08 consists of a control system 1 having the following functional blocks. Up/down counter 1, DA converter, and a control system 2 having the following functional blocks: Up/down counter 2, and DA counter 2. The operating current, I_O follows the following algebraic equation:

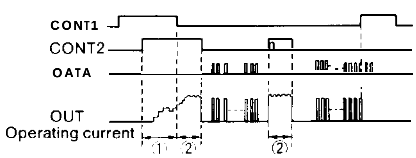
$I_O = I_{F1} + I_{F2} + I_{OS}$

I_{F1} - Set by control systeml
I_{F2} - Set by control system2
I_{OS} - Constant offset current

I_{F1} and I_{F2} are set by an input signal

The method of setting the optical power output is as follows.
First, set one half of the desired optical power output Po using I_{OS} and I_{F1}. Then, set optical power output with control system 2 by using I_{OS}, I_{F1} and I_{F2}. By using both control systems in this manner, the set quantizing error can be kept small.

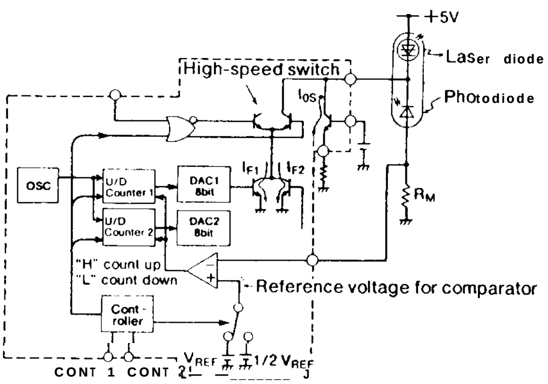
Fig. 33-1 Timing Chart



(1): I_{F1} control system operation
(2): I_{F2} control system operation

CONT 1	CONT 2	Up/down counter 1	Up/down counter 2	Operation
H	H	Count	Reset	I_{F1} current detection
H	L	Reset	Count	Reset (OUT - Low)
L	H	Hold	Count	I_{F2} current detection
L	L	Hold	Hold	Hold

Fig. 33-1 Block Diagram



● Optical Power Output Adjustment When Using Pulse Drive

A pulse optical output of only a few microseconds cannot be measured directly using theSPD102 photodiode. The response of the SPDI 02 is too slow, and its output drops off as shown in Fig. 33-3b. The average optical power output can be measured by connecting a large capacity capacitor in parallel with the load resistance of theSPD102 and making the output direct current This makes it possible to estimate the pulse optical power output from the average optical power output.
However, since fluctuations in the duty ratio and other factors will cause errors, it is recommended that a PIN photodiode be used to increase the accuracy of measurement of optical power output. Since the response of the PIN photodiode is extremely fast, the optical power output waveform can be measured directly as shown in Fig 33-3d.
To accurately measure the absolute optical power output, a photodiode with a large photodetector surface should be used. The circuit used for measurement is illustrated in Fig 33-4. If the sensitivity of the photodiode is 0.5 mA/mW, and the lead used has a resistance of 50 Ω then the value becomes 25mV/mW.
When measuring output power, bring the laser as close as possible to the Photodetector of the PIN photodiode. When measuring high power laser diodes such as the LT021/24/27/17/15 /90/91 series devices, place a neutral density (ND) filter in front of the detecting surface of the PIN photodiode to limit output

Fig. 33-3 Outputs of Photodiodes Receiving Pulse Optical Power Outputs

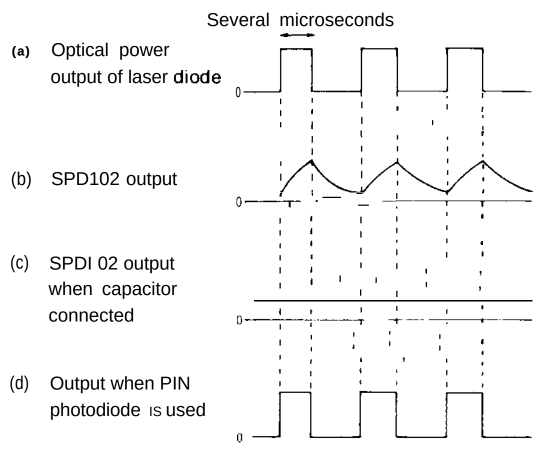
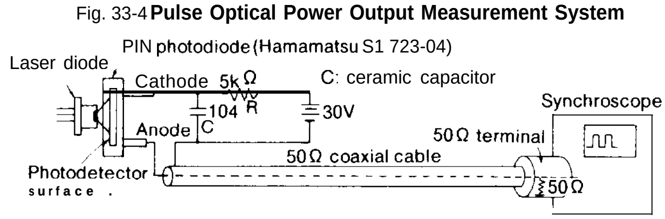


Fig. 33-4 **Pulse Optical Power Output Measurement System**



Note Connect the current limiter resistance R, coupling capacitor C and [he end of the 50Ω coaxial cable near the photodiode