SONY®

Discrete Semiconductor

Data Book 1988

RF & Microwave
Optoelectronics
Discrete Silicon

SONY®

Discrete Semiconductor Data Book

1988

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PREFACE

The history of Sony semiconductors began over 30 years ago in 1954, with the first commercial introduction of the transistor in Japan. Since then, Sony has applied this leading-edge, innovative technology in the development of the semiconductors, currently used in most of its electronic products.

This discrete semiconductor data book has been compiled with the aim of providing the circuit designer with a reference guide describing Sony's presently available product line, together with application information for each category of discrete semiconductors.

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Silicon Epitaxial Planer

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1T362	UHF/VHF tuning	Super minimold package of 1T32, $\Delta C \leqq 3\%$	56
1T33/T/A/AT	CATV tuning	Small package $\Delta C \leqq 3\%$ (type A is 2%)	59
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Note) ΔC: Maximum capacitance deviation for same rank.

2) Laser Diodes

GaAlAs Visible Laser Diode

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2) Laser Diodes (continued)

GaAlAs Visible Laser Diode

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* SLD300 series will have other packages available during 1988:
S = Open heat sink
WT = TO-3 with a built-in TE cooler
X = Flat
XT = Flat with a built-in TE cooler

3) Field Effect Transistors

(A) Silicon N-Channel junction FET

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3) Field Effect Transistors

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3) Field Effect Transistors

(C) GaAs N-Channel Dual Gate MES FET

Type	Application	Feature	Page
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3SK165	UHF amplifier, mixer, oscillator	Low input capacitance Ciss=0.5pF, High power gain PG Max=20dB, Low noise NF (Typ.)=1.2dB(F=800MHz) 4 Pin minimold	177
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4) Magneto-Resistance Elements (*SDME)

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* Sony Divider-type Magneto-Resistance Element

1. List of Model Names

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1T359	65	3SK164/-M	173	SLD204V	92
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* SLD300 series will have other packages available during 1988:
S = Open heat sink
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X = Flat
XT = Flat with a built-in TE cooler

2. Description

1) Nomenclature of Sony Semiconductors

Names of Sony FET devices are based on the semiconductor nomenclature method of the Japan Industrial Standards (JIS C7012). For other semiconductors (diodes, laser diodes and magnetoresistance elements), Sony's own nomenclature is used. The following is an explanation of how each device is named.

(1) Nomenclature of diodes

IT □□□

□□□ — Indicates the product No. for each individual device.

IT — Indicates the symbol of a Sony diode.

(2) Nomenclature of laser diodes

SLD □□□ □

□ — Indicates a package type (alphabet).

□□□ — Indicates the product No.

SLD — Indicates the symbol of a Sony laser diode.

(3) Nomenclature of field effect transistors

No.1	No.2	No.3	No.4	No.5
(Figure)	(Letter)	(Letter)	(Figure)	(Suffix)

The No.1 figure denotes the type of semiconductor device.

The device's number of effective electrical connections minus one is used for this number (n−1).

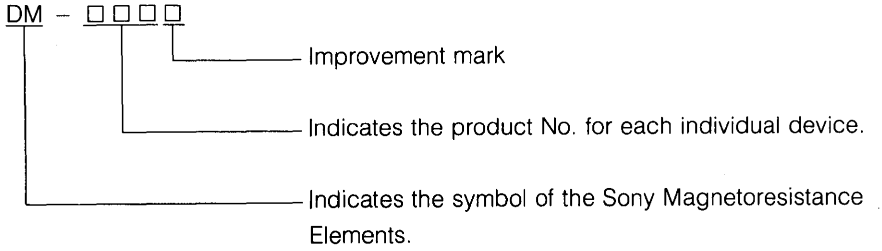
The No.2 letter shows the symbol "S" representing semiconductor devices registered with the Electronic Industries Association of Japan (EIAJ).

The No.3 letter shows the polarity and application of the semiconductor device. For example, "K" indicates an N-Channel FET.

The No.4 figure represents a sequential number registered with the Electronic Industries Association of Japan for each of the preceding types (No.1 figure, No.2 and No.3 letters).

The No.5 suffix uses letters in sequence (A, B, C, ...) each time the device specifications are modified.

(4) Nomenclature of magnetoresistance elements



2) Ratings and Characteristics

(1) Absolute maximum ratings

The reliability of semiconductors chiefly depends on two factors. One, needless to say, is the manufacturing quality. The other can be defined as the "operating conditions" which are selected by the user. That is, selection of the circuit, and environmental conditions, among other factors, play an important role.

Thus, to ensure the highest degree of reliability in the usage of semiconductors, proper selection is a key point. To this effect the absolute maximum ratings should be carefully taken into consideration.

What are Absolute maximum ratings

The maximum ratings are usually given with the semiconductor specifications. The values should not be exceeded, even momentarily.

Exceeding these values, even for a moment, will adversely affect the device, inducing premature aging or breakdown. Breakdown may not occur immediately, but still, service life would be drastically shortened. Also, any **Two** items from those ratings **SHOULD NOT** reach their maximum value at **THE SAME TIME**. When designing a circuit, the following items, at their worst condition, should be taken into account to avoid overrunning the absolute maximum ratings.

- Fluctuation of the supply voltage
- Irregularity in the electrical characteristics of the electric parts, such as FETs, resistors or capacitors
- Power loss during circuit adjustment
- Ambient temperature
- Fluctuation of input signals
- Input of abnormal pulses

For pulse application usage, be careful with the Area of Safe Operation (ASO), operation amplitude, peak voltage and current.

(2) Diodes maximum ratings (Variable capacitance diodes, Photo diodes, Schottky barrier diodes)

Item	Symbol	Definition
Peak reverse voltage	V_{RM}	The maximum allowable value of AC voltage applied in reverse where the average voltage is kept below V_R
Reverse voltage	V_R	Maximum allowable value of DC voltage applied in reverse
Forward current	I_F	Maximum allowable value of average rectifying current or DC current that can be applied
Operating temperature	T_{opr}	The maximum allowable value of ambient temperature where operation is possible under normal heat dissipating conditions
Junction temperature	T_j	Maximum allowable value of the junction temperature. This temperature is the sum of the ambient temperature during operation and the rise in temperature due to internal power dissipation (PD) of the diode itself
Storage temperature	T_{stg}	The lower and upper limit of the ambient temperature that should not be exceeded when the diode is stored in a state of non operation

2-1) Electrical Characteristics of Variable Capacitance Diodes

Item	Symbol	Definition
Reverse breakdown voltage	V_{RM}	Applied reverse voltage when normal reverse current flows
Reverse current	I_R	The current that flows in reverse when normal voltage is applied
Pin interval capacitance	C_2	Pin interval capacitance when a 2V reverse voltage is applied
Capacitance ratio	C_2/C_{25}	Ratio of the pin interval capacitance when a 2V reverse voltage is applied
Series resistance	r_s	High frequency series resistance under specified conditions
Performance exponent	Q	Ratio between dissipated and stored energy
Maximum capacitance deviation in the same rank	ΔC	Indicates the amount of capacitance deviation and is defined through the following formula $\Delta C = \frac{C_{max} - C_{min}}{C_{min}} \times 100\ (\%)$
Capacitance variation rate	n	The capacitance variation rate is expressed through the following formula $n = -\frac{V}{C}\frac{dC}{dV}$
High frequency distortion	P	High frequency distortion is expressed through the following formula $P = \frac{1}{8}\left\{\frac{1}{C} \bullet \frac{d^2C}{dV^2} - \frac{4}{3}\left(\frac{1}{C} \bullet \frac{dC}{dV}\right)^2\right\} \times 100\ (\%)$

2-2) Electrical Characteristics of Photo Diodes

Item	Symbol	Definition
Forward voltage	V_F	Voltage between pins when normal current flows forward
Dark current	I_D	The current when normal voltage is applied with the photodiode kept in the dark
Pin interval capacitance	C_1	Capacitance between focus diode and cathode
Pin interval capacitance	C_2	Capacitance between tracking diode and cathode
Sensitivity	S	The amount of photocurrent per unit incident light at a standard wavelength

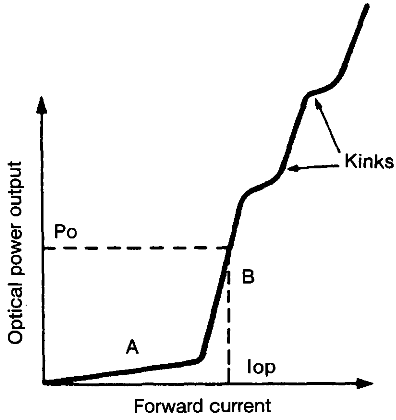
2-3) Electrical Characteristics of the Schottky Barrier Diodes

Item	Symbol	Definition
Pin capacitance	C_T	Capacitance between anode and cathode under normal conditions
Conversion loss	L_C	Loss occurring after frequency conversion under normal conditions
Series resistance	R_S	Normal forward bias series resistance

3) Absolute Maximum Ratings of Laser Diodes

Item	Symbol	Definition
Optical power output	Po	Maximum allowable instantaneous optical power output under continuous (CW) operation. Up to this output level, there are no kinks in the current vs power output curve.
Reverse voltage	VR	Maximum allowable voltage when reverse bias is applied to either the laser diode or photodiode.
Operating temperature	Topr	Range of case temperatures within which the device may be safely operated.
Storage temperature	Tstg	Range of case temperatures within which the device may be safely stored.
Case temperature	Tc	Device temperature measured at the base of the package.

Optical Power Output vs. Forward Current.



3-1) Electro-Optical Characteristics

Item	Symbol	Definition
Forward Current	IF	Current through the laser diode under forward bias.
Threshold Current	Ith	The boundary between spontaneous emission (region A) and stimulated emission (region B) on the optical power output vs. forward current curve.
Operating Current	Iop	The forward current through the laser diode necessary to produce its specified optical power output.
Operating Voltage	Vop	The forward voltage across the laser diode when the device produces its specified optical power output.

Item		Symbol	Definition
Wavelength		λ	The wavelength of the light emitted by the laser diode. For a single mode device, this is the wavelength of the single spectral line of the laser output. For a multi-mode device, this is the wavelength of the spectral line with the greatest intensity.
Monitor Current		Im	The current through the photodiode, at a specified reverse bias voltage, when the laser diode is producing its specified power output.
Beam Divergence		$\theta /\!/$, $\theta \perp$	The laser beam's full width, half-maximum intensity points (FWHM), measured both parallel and perpendicular to the junction plane.
Positional accuracy	Angles	$\Delta\phi /\!/$, $\Delta\phi \perp$	The deviation of the optical axis of the beam from the mechanical axis of the package, measured both parallel and perpendicular to the junction plane.
	Position	$\Delta x, \Delta y, \Delta z$	Displacement of the laser diode chip with respect to the device package. Δx and Δy are measured as the planer displacement of the chip from the physical axis of the package. Δz is measured perpendicular to the reference plane.
Slope Efficiency		η_D	The mean value of the incremental change in laser power output for an incremental change in forward current. $\eta = \frac{\Delta Po}{\Delta I_F}$
Thermal Resistance			The incremental change in the laser diode junction temperature for an incremental change in the power dissipation of the laser chip.
Signal to Noise Ratio		S/N	Noise is defined as the fluctuation over time of the intensity of the laser diode output, when driven by a DC input. The signal to noise ratio is expressed in terms of the mean output power, P. and the fluctuation δP, as: $S/N = 10 \log (P/\delta P)$ decibels. Noise includes; 1) mode hopping noise caused by temperature changes at the laser diode junction, and 2) optical feedback noise caused by the formation of a complex resonator when part of the laser beam is reflected back into the laser diode.

Item	Symbol	Definition
Astigmatism	As	The laser beam appears to have different source points for the directions perpendicular and parallel to the junction plane. The astigmatic distance is defined as the distance between the two apparent sources. A large astigmatism must be corrected if the laser beam is to be accurately focused.
Polarization Ratio		The light from a laser diode emitting in an ideal single mode is linearly polarized parallel to the junction plane. Spontaneous emission adds unpolarized light which has a component of polarization perpendicular to the junction plane. The polarization ratio is defined as the ratio of the component of polarization parallel to the junction plane to the component perpendicular to the junction plane.

(4) Maximum ratings of FET

Item	Symbol	Definition
Drain to Gate Voltage	V_{DGO}	Maximum voltage applicable across drain and gate when the source is open.
Source to Gate Voltage	V_{SGO}	Maximum voltage applicable across source and gate, when the drain is open.
Drain Current	I_D	Maximum DC current applicable to the drain continuously, within the allowable channel dissipation.
Gate Current	I_G	Maximum DC current applicable to the gate continuously, within the allowable channel dissipation.
Allowable Power Dissipation	P_D	Maximum channel dissipation that can be continuously consumed by the FET, under specified heat dissipating conditions.
Channel Temperature	T_{ch}	Maximum value of the channel temperature which must not exceed the sum of: the ambient temperature while in operation (Ta), and the temperature rise due to the device's inner power dissipation.
Storage Temperature	T_{stg}	The lower and upper limits of the ambient temperature that should not be exceeded when the device is stored.

4-1) FET Electrical Characteristics

Item	Symbol	Definition
Drain to Gate voltage	V_{DGO}	Drain to Gate voltage with Source open
Source to Gate voltage	V_{SGO}	Source to Gate voltage with Drain open
Gate to Source voltage	V_{GSS}	Gate to Source voltage with Drain-Source Short
Drain to Source voltage	V_{DSX}	Drain to Source voltage under normal conditions
Gate to Source cutoff voltage	$V_{GS(OFF)}$ $V_{G1S(OFF)}$ $V_{G2S(OFF)}$	Gate to Source cutoff voltage under normal conditions
Drain current	I_{DSS}	Drain current with Gate-Source Short
Gate cutoff current	I_{GSS} I_{G1SS} I_{G2SS}	Gate leakage current with Drain-Source Short
Drain OFF current	$I_{D(OFF)}$	Drain current when voltage is applied at Gate-Source to bias the FET off.
Gate 2 to Drain leak current	I_{G2DO}	Gate 2-Drain Leakage current with normal voltage applied at Gate 2-Drain
OFF resistance	R_{OFF}	Drain-Source resistance with normal voltage applied at Gate-Source and cut OFF condition
ON resistance	R_{ON}	Drain-Source Resistance with FET ON
Input resistance Input capacitance	r_{ip} C_{ip}	Input admittance: $Y_I = \frac{1}{r_{ip}} + j\omega C_{ip}$

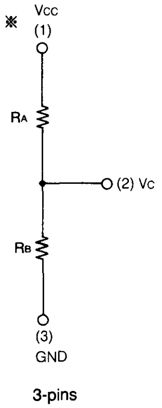
Item	Symbol	Definition
Output resistance, Output capacitance	r_{op} C_{op}	Output admittance: $Y_O = \frac{1}{r_{op}} + j\omega C_{op}$
Feedback capacitance	C_{rss} C_{dg}	Drain-Gate capacitance with Common Source Drain-Gate capacitance under normal conditions
Gate to Drain capacitance	C_{gd}	Gate-Drain capacitance with Gate-Source Short
Gate to Source capacitance	C_{gs}	Gate-Drain capacitance with Gate-Source Short
Input capacitance	C_{ISS}	Input capacitance with Common Source
Forward transfer admittance	$\lvert Y_{fs} \rvert$	Ratio of input voltage ΔV_{GS} and output current ΔI_D under normal conditions $\lvert Y_{fs} \rvert = \frac{\Delta I_D}{\Delta V_{GS}}$
Reverse transfer coefficient	S_{12}	Reverse transfer coefficient with input and output terminated by characteristic impedance.
Input equivalent noise voltage	$\bar{e}_n$	$\bar{e}_n = \sqrt{4kTR_N}$ K: Boltzmann's constant T: Absolute temperature (°K) 1/f noise added to Johnson Noise generated at equivalent Noise resistance R_N
Power gain noise	PG	Maximum power gain under normal conditions
Noise figure	NF	$NF = \frac{\text{Input signal vs. Noise ratio}}{\text{Output signal vs. Noise ratio}}$
Gain (NF minimum)	G_a	Power gain under matching conditions leading to NF minimum
Inter modulation	IMD	Third distortion component level (dB) at 0dB signal level

(5) Maximum ratings of Magnetoresistance Elements

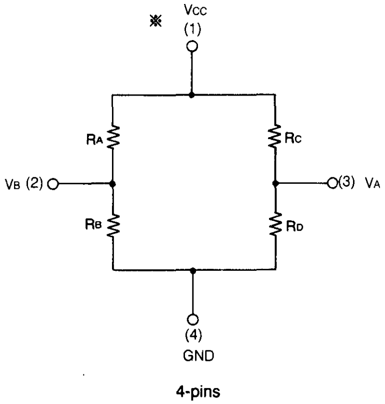
Item	Symbol	Definition
Supply voltage	V_{CC}	Maximum voltage applicable between Supply-Ground pins
Operating temperature	T_{opr}	Ambient temperature that ensures full performance of the Magnetoresistance functions during operation.
Storage temperature	T_{stg}	Allowable ambient temperature for storage without operation.

(5-1) Electrical characteristics

Equivalent circuit of the Magnetoresistance Element



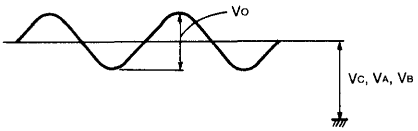
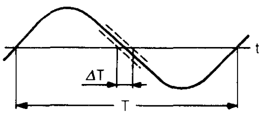
3-pins



4-pins

※ Refer to the Equivalent circuit.

Item	Symbol	※Definition	Unit
Total resistance	R_T	3-pins Magnetoresistance Element $R_T=R_A+R_B$ 4-pins Magnetoresistance Element $R_T=(R_A+R_B)//(R_C+R_D)$	kΩ
Output voltage	V_O	Output voltage amplitude for pins (2) and (3). Measure Magnetoresistance Element at rotary magnetic field for pin 3, and at AC magnetic field for pin 4.	mVp-p

Item	Symbol	Definition	Unit
Midpoint voltage	V_C V_A V_B	V_C, V_A and V_B voltages (DC voltage)  Measure Magnetoresistance Element at rotary magnetic field for pin 3, and at AC magnetic field for pin 4.	V
Midpoint Potential	$\|V_A-V_B\|$	Difference between center Potentials V_A and V_B of pin 4 Magnetoresistance Element.	mV
Resistance change ratio	$\frac{\Delta\rho}{\rho}$	$R\perp$: Resistance value when current crosses with the magnetic direction, orthogonally. $R//$: Resistance value when current is parallel to magnetic direction. Then, the resistance change ratio is $\frac{R_{//}-R_{\perp}}{R_T} \times 100$	%
FG Fluctuation		Fluctuation of the output waveform on the time axis. FG fluctuation $= \frac{\Delta T}{T} \times 100$ 	%

3) Quality Assurance and Reliability Test Standards

1) Quality Assurance

The quality and reliability of semiconductor products is ensured at the designing and manufacturing stages. Our basic policy is ZD (Zero Defects).

In addition to inspections executed during these processes and final checks, a sampling inspection for every consignment lot is held to determine whether the quality level has been kept or not.

(2) Reliability

Reliability assessment is conducted through periodic reliability tests.

The following chart illustrates an example.

Periodic Reliability Test[1]

Item	No of Testing Hours	LTPD[2] (%)
Electrical Characteristics Test	To determine the initial quality level, some types are selected and tested again.	
Life Test		
high temperature operation	up to 1000 h	10%
high temperature with bias	up to 1000 h	10%
high temperature storage	up to 1000 h	10%
low temperature storage	up to 1000 h	10%
high temperature and high humidity storage	up to 1000 h	10%
high temperature and high humidity with bias	up to 500 h	10%
pressure cooker	up to 200 h	10%
Environmental Test		
soldering heat resistance	10 sec	15%
heat cycle	10 cyc	15%
Mechanical Test		
solderability	Japan Industrial Standard (JIS)	15%
length strength		15%
Other Tests If necessary, tests are selected according to JIS C7021 and EIAJ SD121.		

Note:

1) These tests are selected by sampling standard.
2) Lot Tolerance Percent Defective

These tests and inspection data are not only for the estimation of quality but also serve as data for the improvement of design and wafer processes.

Reliability Test Standard for Acceptance of Products

Types of Test	Condition	Supply Voltages	No of Testing Hours	LTPD (%)
high temperature operation	Ta=125°C, 150°C	Typ.	1000 h	5%
high temperature with bias	Ta=125°C, 150°C	Typ.	1000 h	5%
high temperature storage	Ta=150°C		1000 h	5%
low temperature storage	Ta=−65°C		1000 h	5%
high temperature and high humidity storage	Ta=85°C 85%RH		1000 h	5%
high temperature and high humidity storage	Ta=85°C 85%RH	Typ. (1h on/3h off)	1000 h	5%
pressure cooker	Ta=121°C 100%RH 30 pounds per square inch		200 h	5%
temperature cycle	Ta=−65°C to +150°C		100 cyc	10%
heat shock	Ta=0 to +150°C		5 cyc	10%
soldering heat resistance	T solder=260°C		10 sec	10%
solderability	T solder=230°C (rosin type flux)		5 sec	10%
mechanical shock	X, Y, Z 1500G half part of sinusoidal wave of 0.5 ms		3 times for each direction	10%
vibration	X, Y, Z 20G 10 Hz to 2000 Hz to 10 Hz (4 min) sinusoidal wave vibration		16 minutes for each direction	10%
constant acceleration	X, Y, Z 20,000G centrifugal acceleration		1 minute for each direction	10%

Types of Test	Condition	Supply Voltages	No of Testing Hours	LTPD (%)
fall by gravity	falling from the height of 75 cm to maple plate by gravity		3 times	10%
lead strength (bend) (pull)	Japan Industrial Standard (JIS)			
electrostatic strength	Device design is reviewed, when electrostatic strength below standard supplies surge voltage to each pin under C=200pF and Rs=0Ω conditions.			

4) Laser Diodes

4-1) Introdction

The semiconductor laser diode is a rapidly growing field driven by many applications, such as Compact Disc players for consumer use and laser printers for office use.On the low end of the power scale are the 3 to 10 mW,780 nm lasers intended primarily as light sources for Compact Disc and Video Disc players,laser printers,bar-code readers,and optical LAN systems.Power levels in the 10 to 100 mW range are suitable for fiberoptic communications and writable/erasable optical disks such as WORM (Write-Once Read-Many) and MO (Magneto-Optical) systems.Up until now,no laser manufacturer has been able to offer lasers above 500 mW in commercial quantities.

Sony has been conducting research on MOCVD technology since the early 1970's, and in 1979 the first visible laser diode fabricated by MOCVD was successfully operated in CW mode.Further development culminated in the introduction of the low noise, long life laser (SLD101U) for Compact Disc players in 1984.This 780 nm gain-guided laser features low noise,low cost and high reliability made possible by the high uniformity,productivity and quality of the starting MOCVD epitaxial substrate.A slanted glass cap on the package is used to correct and reduce the astigmatism inherent with gain-guided lasers down to levels comparable to index-guided lasers.

The SLD101U was followed by various improved models as shown at right, reflecting the continuous improvements made on the original product to reduce size, improve performance and meet the market requirements.

In the medium power range up to 100 mW, Sony currently offers both gain-guided and index-guided lasers.The gain-guided types are called TAPS (Tapered Stripe) and the index-guided types are called SAN (Self-Aligned Narrow Stripe),to indicate the differences in structure and optical confinement.

MODEL	FEATURE
SLD101 U	First compact disc laser diode with slanted cap glass to correct astigmatism
SLD102U	Laser chip mounted on silicon photodiode to simplify assembly and screening
SLD103U	New miniaturized package, jointly developed by Sony and Sharp

Gain-guided lasers (eg.SLD201U,SLD202V) offer multiple-mode spectra which minimize mode hopping noise,and the simple epitaxial structure allows high reliability and low-cost designs.The unique tapered stripe cavity produces a single-lobed far-field pattern.The astigmatism can be corrected by means of a slanted glass cap on the package to typically less than 10 microns.Optical designers who prefer to do their own correction (by using a cylindrical lens,for example) can obtain the lasers with a flat glass cap.

Index-guided lasers (eg.SLD203V, SLD204V) offer single-mode spectra,a low threshold current level,and a small level of astigmatism of around 5 to 7 microns.These lasers are particularly suited for high-density optical disks,such as the 12-inch and 5¼-inch WORM systems and erasable MO systems.

It has generally been assumed that the width of the laser cavity cannot be made arbitrarily large in a semiconductor laser due to the imperfections and inhomogeneity in the epitaxial layer,causing uneven current densities and optical amplification.Prototype lasers above 100 mW have all been realized using multiple-stripe parallel structures.This method has major problems with production yield,as well as the resulting beam quality.

Sony has successfully demonstrated that it is possible to fabricate a single broad-stripe laser capable of delivering more than 1 watt of radiant power.This has been made possible by means of the very high quality and uniformity achievable with MOCVD crystals together with the device processing technology.With other competing technologies such as Liquid Phase Epitaxy (LPE),it is not possible to obtain adequate uniformity of the water surface to allow fabrication and proper operation of these broad-stripe lasers with very simple structures.

There are numerous potential applications for lasers of this power,particularly in medical, industrial, and energy fields. A typical example would be the pumping of YAG lasers.The small size,high reliability,small power consumption,and the possibility of fine-tuning the laser wavelength (using TE coolers) to match the YAG absorption spectra,are significant advantages.Other new applications,such as automobile collision avoidance,free-air optical communications, and liquid-crystal panel excitation are but only a few of the infinitely many possible uses of these high power lasers.Sony welcomes ideas for new and innovative uses of these lasers,as well as suggestions for exploring possibilities of conducting custom or joint development with customers to tailor the products for specialized markets and needs.

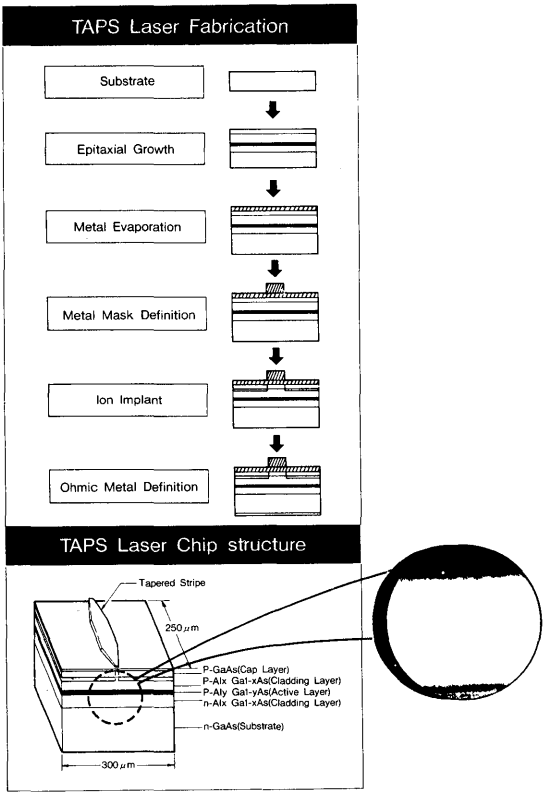
4-2) STRUCTURE OF LASER DIODES

The structure of Sony's laser diodes can be classified into three general categories: TAPS (Tapered stripe), SAN (Self-aligned narrow stripe) and BROAD-AREA.

TAPS lasers are gain-guided, narrow stripe lasers with a tapered stripe width (narrow at the cavity edges, see Fig 1) in order to generate a single-lobed far-field beam pattern. This structure is employed in the SLD100 series and part of the SLD200 series lasers.

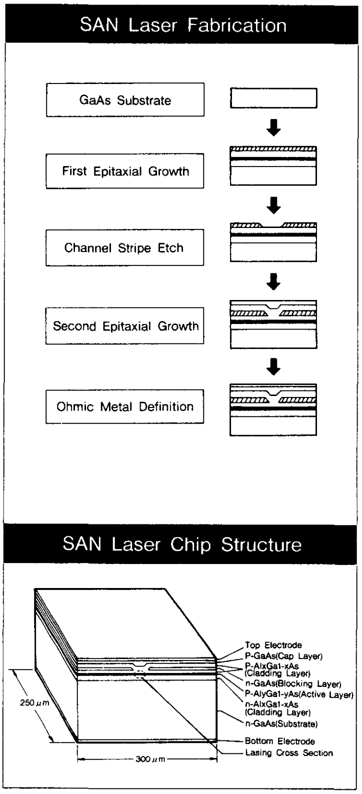
SAN lasers are index-guided, narrow stripe lasers, fabricated using an advanced two-step epitaxial process. The SLD203V and SLD204V are lasers of this category (Fig 2).

Broad-area, single stripe lasers are a recent addition to Sony's laser product line. They are used for the SLD300 series. This structure, shown in Fig 3, is suitable for producing large optical power. In contrast to multiple-stripe structures used by many laser manufacturers, the single-stripe approach is more simple, resulting in higher reliability, better production yield, and above all, a better beam quality. The fabrication process is basically identical to that of TAPS lasers.



TAPS : Tapered Stripe

Fig 1



SAN : Self Aligned Narrow stripe

Fig 2

BROAD AREA LASER CHIP STRUCTURE

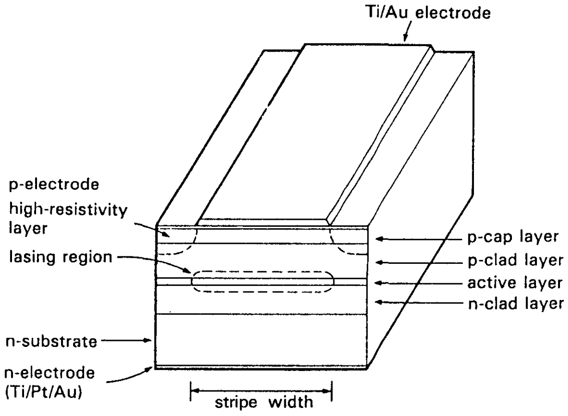
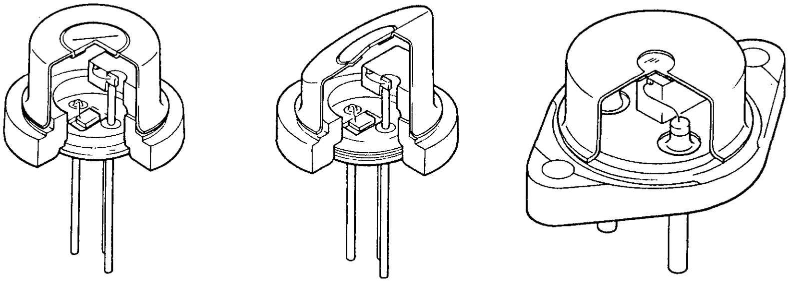


Fig. 3

Various Package Types



TYPE V

9 mm diameter,
flat glass cap

TYPE U

9 mm diameter,
slanted glass cap

TYPE W
TO-3

flat glass cap

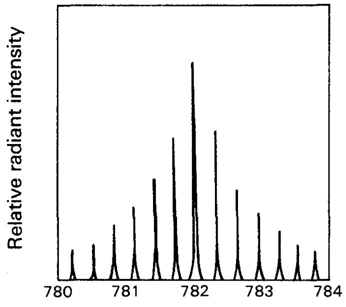
Fig. 4

4-3) Optical Properties

Sony's laser diodes operate in the visible and near-infrared section of the electromagnetic spectrum,between 760 and 840 nanometers.With the exception of two models (SLD203V and SLD204V),all are gain-guided lasers.This section describes briefly the major optical characteristics of Sony's laser diodes.

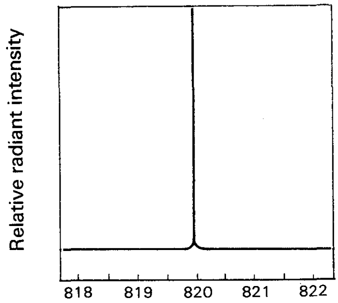
4-3-1) Longitudinal Mode

The longitudinal mode,or spectral content, of a laser diode's output beam is determined primarily by the semiconductor material of the diode chip,the dimensions of the lasing cavity,and the mode of optical confinement (ie. gain-guided or index-guided).Gain-guided lasers generally exhibit longitudinally multimode oscillations whereas index-guided lasers are single-mode,as shown in Fig 5 and 6 The individual peaks of a multi-mode spectrum are evenly spaced,and the typical width of a single peak is less than 0.01 nanometers.



λ=Wavelength (nm)

Fig5

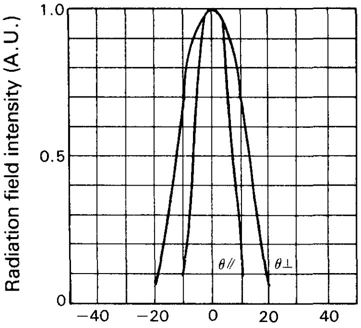


λ=Wavelength (nm)

Fig6

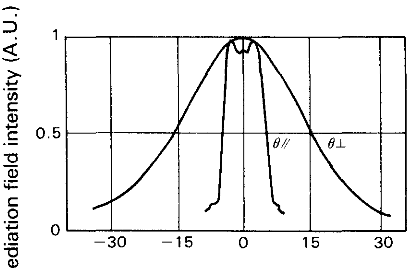
4-3-2) Transverse Mode

The transverse mode determines the spatial distribution of the radiant power across the beam.All laser diodes with thin active layers operate in the fundamental (first-order) transverse mode,also known as the TEMoo mode.The SLD100 and SLD200 series display single-lobed far-field beam patterns.The SLD300 series also display "nearly single-lobed" far-field patterns,making them easy to focus and concentrate the beam.Typical far-field patterns of an SLD201V and SLD303V are shown in Fig 7 and 8,respectively.



Angle (deg)

Fig7

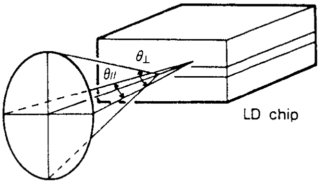


Angle (deg)

Fig 8

4-3-3) Astigmatism

The two beam components $\theta_{//}$ (theta parallel) and $\theta_{\perp}$ (theta perpendicular) of a laser diode's beam originate at different points.The parallel component originates at the laser chip's facet,while the perpendicular component originates within the chip,typically 3 to 7 microns for index-guided lasers and 20 to 30 microns for gain-guided lasers,as shown in Fig 9.This difference in focal point results in astigmatism.



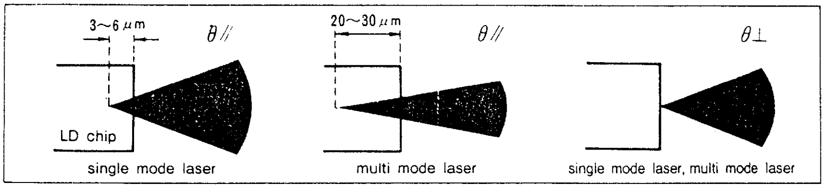


Fig 9

In order to reduce the inherently large astigmatism of gain-guided lasers to levels comparable with index-guided lasers,Sony employs slanted glass caps on its laser packages.Flat-cap packages are also available if astigmatic correction is not desired.Fig 10 shows the relationship between astigmatism, coma and tilt angle of the glass cap for two different glass thicknesses.All current Sony lasers have a glass thickness of 250 microns.

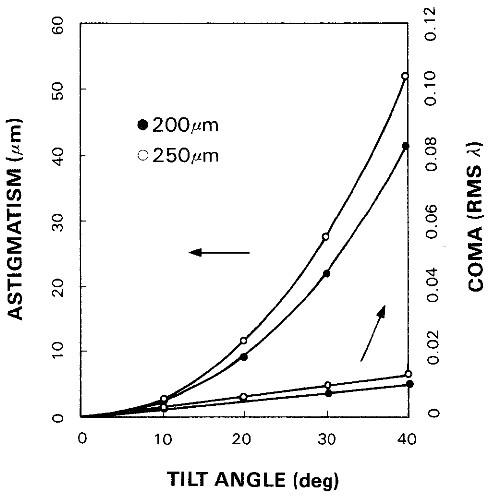


Fig 10

4-3-4) Temperature Dependence

The various optical properties of a laser diode exhibit a dependence with junction temperature and operating current (or power) level.Shown below and on the following pages are some examples of the temperature dependence of operating current,wavelength, beam characteristics, and photodiode current(All data are typical examples,and the actual characteristics will vary from device to device).

Operating Current vs. Temperature

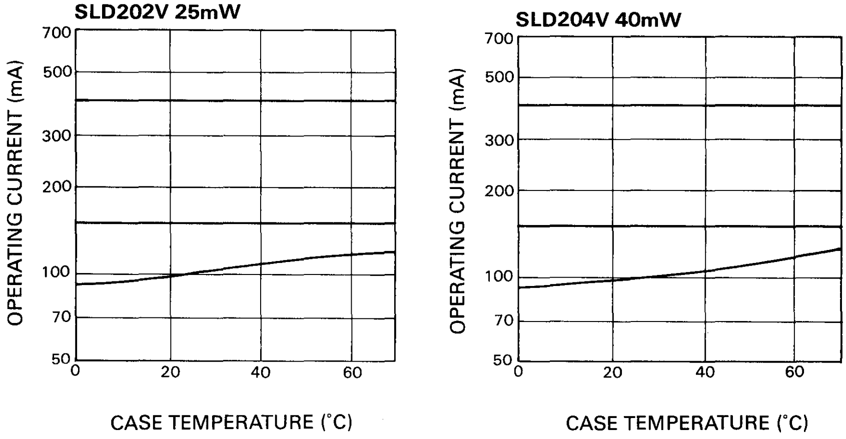


Fig 11

Wavelength vs. Temperature

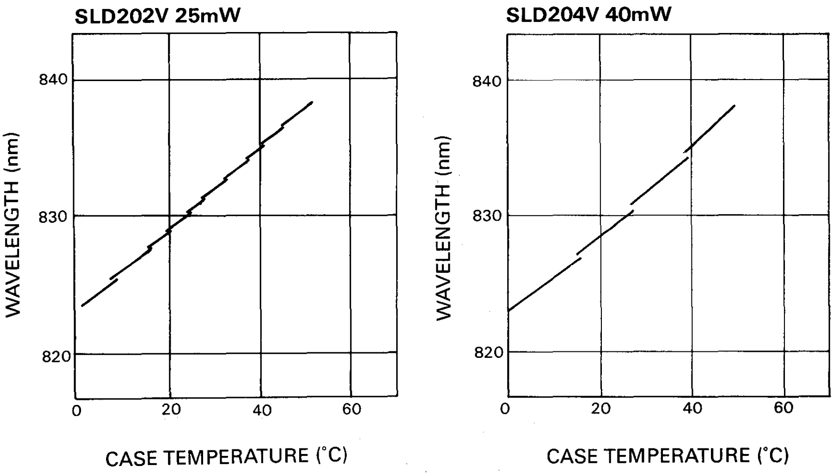
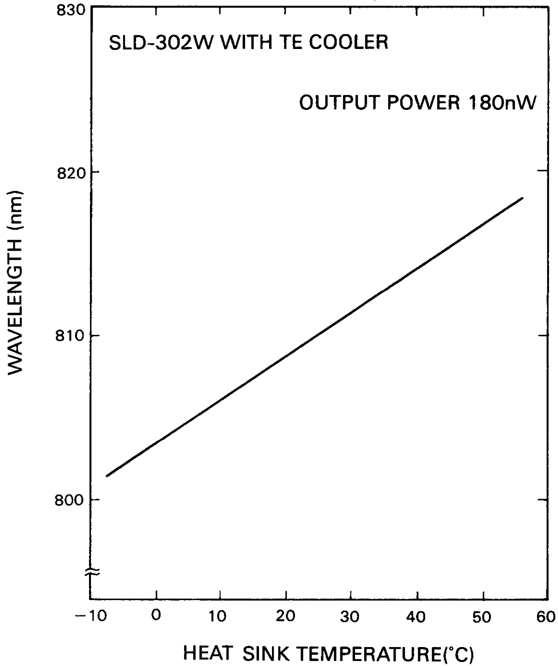
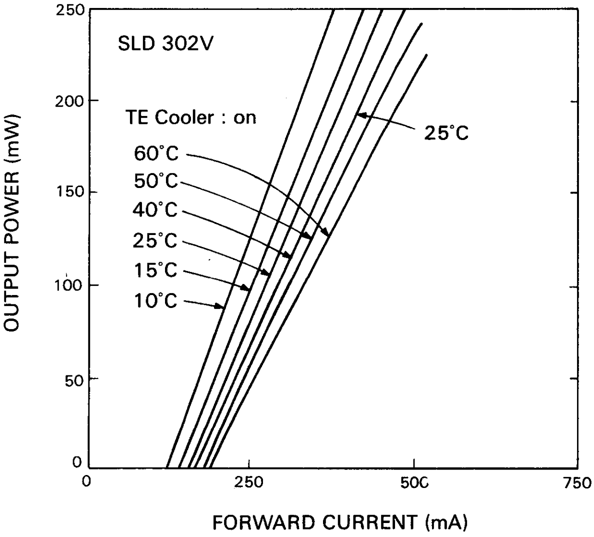


Fig 12



Wavelength vs. Temperature

Fig 13

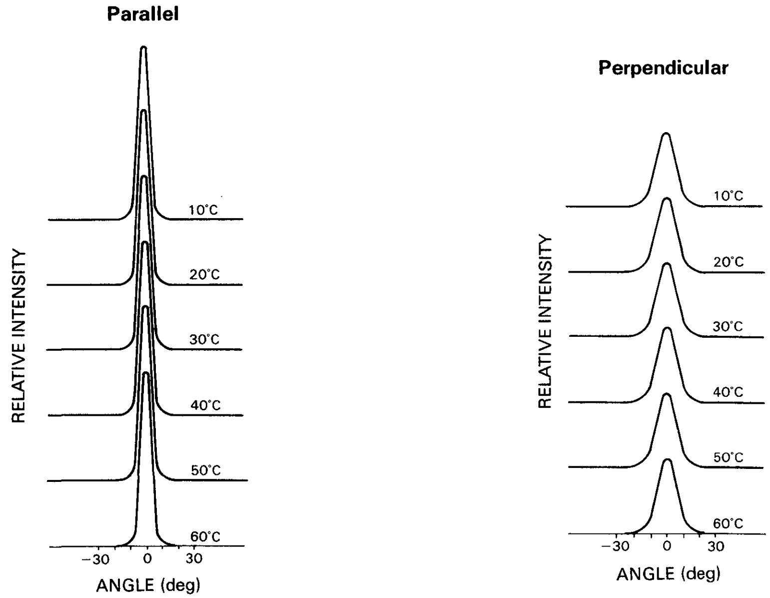


Light-Current Characteristic

Fig 14

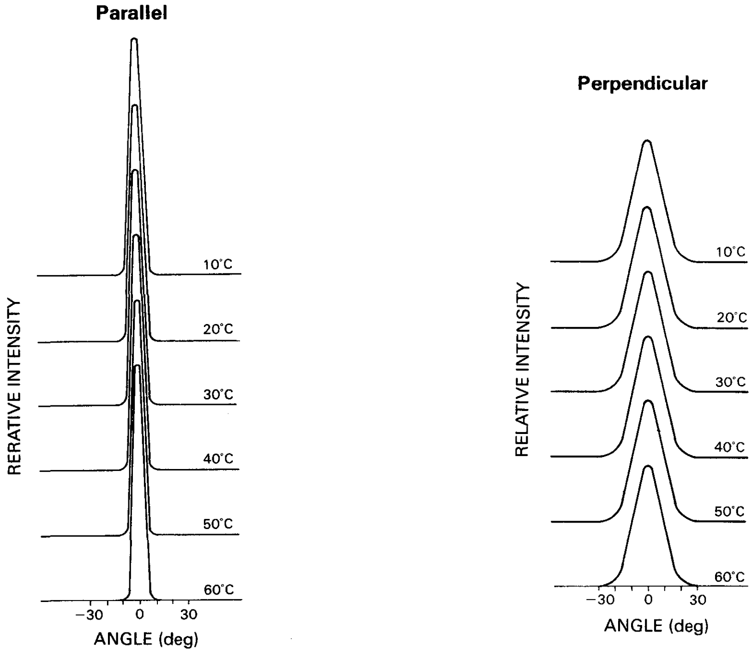
SLD202V

Far-Field Pattern vs. Temperature


Parallel

Perpendicular

SLD204V


Parallel

Perpendicular

Fig 15

Slope Efficiency vs. Temperature

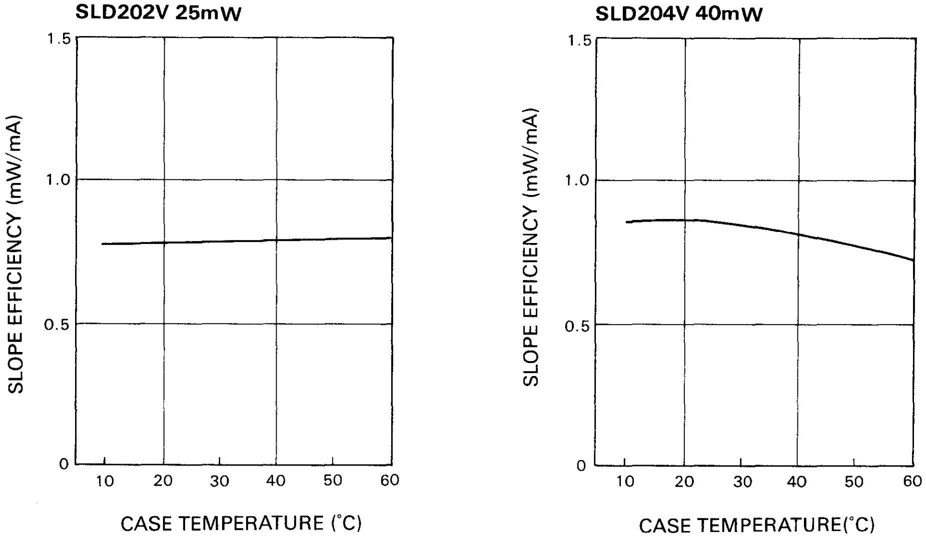


Fig 16

Monitor Current vs. Temperature

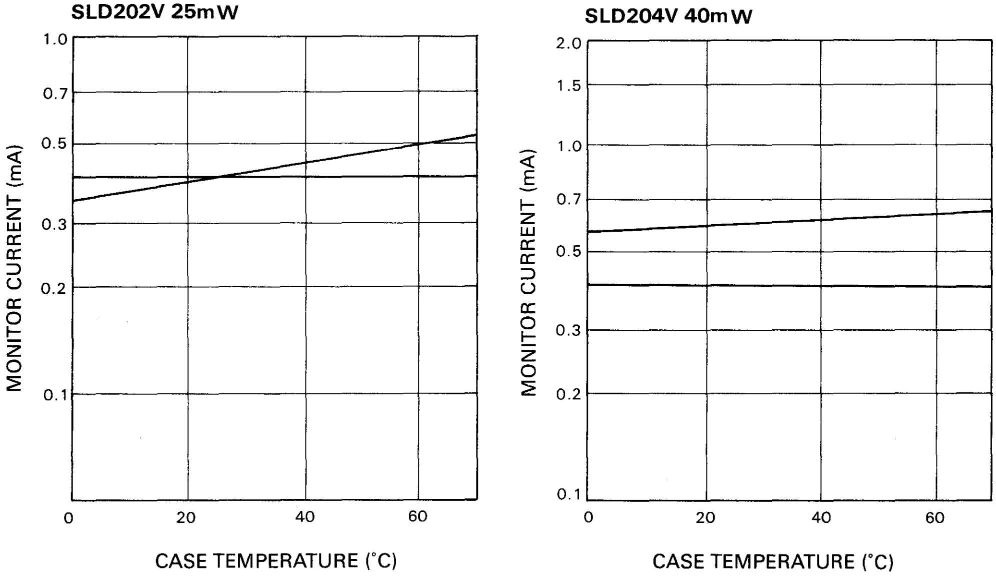


Fig 17

4-3-5) Output Power Dependence

The operating current (and power) of the laser diode influences the optical properties. Some major dependences which may affect the design of the optical systems which incorporate these laser diodes are shown below and on the following pages:

Wavelength vs. Output Power

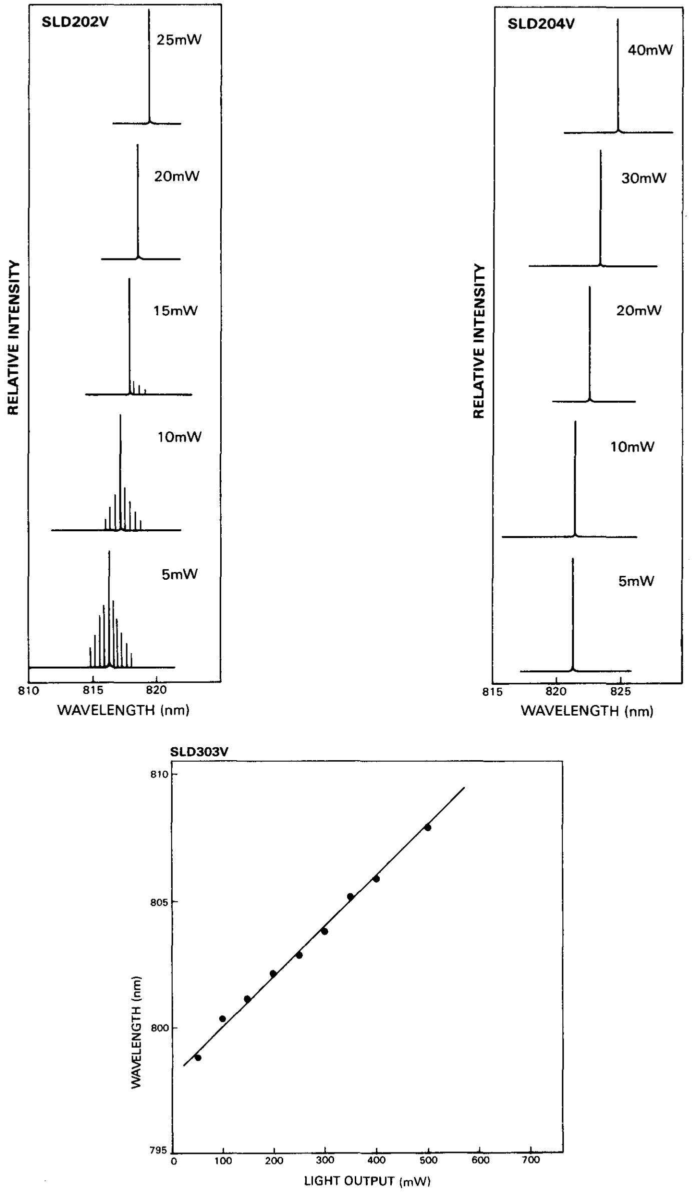


Fig 18

Far-Field Pattern vs. Output Power

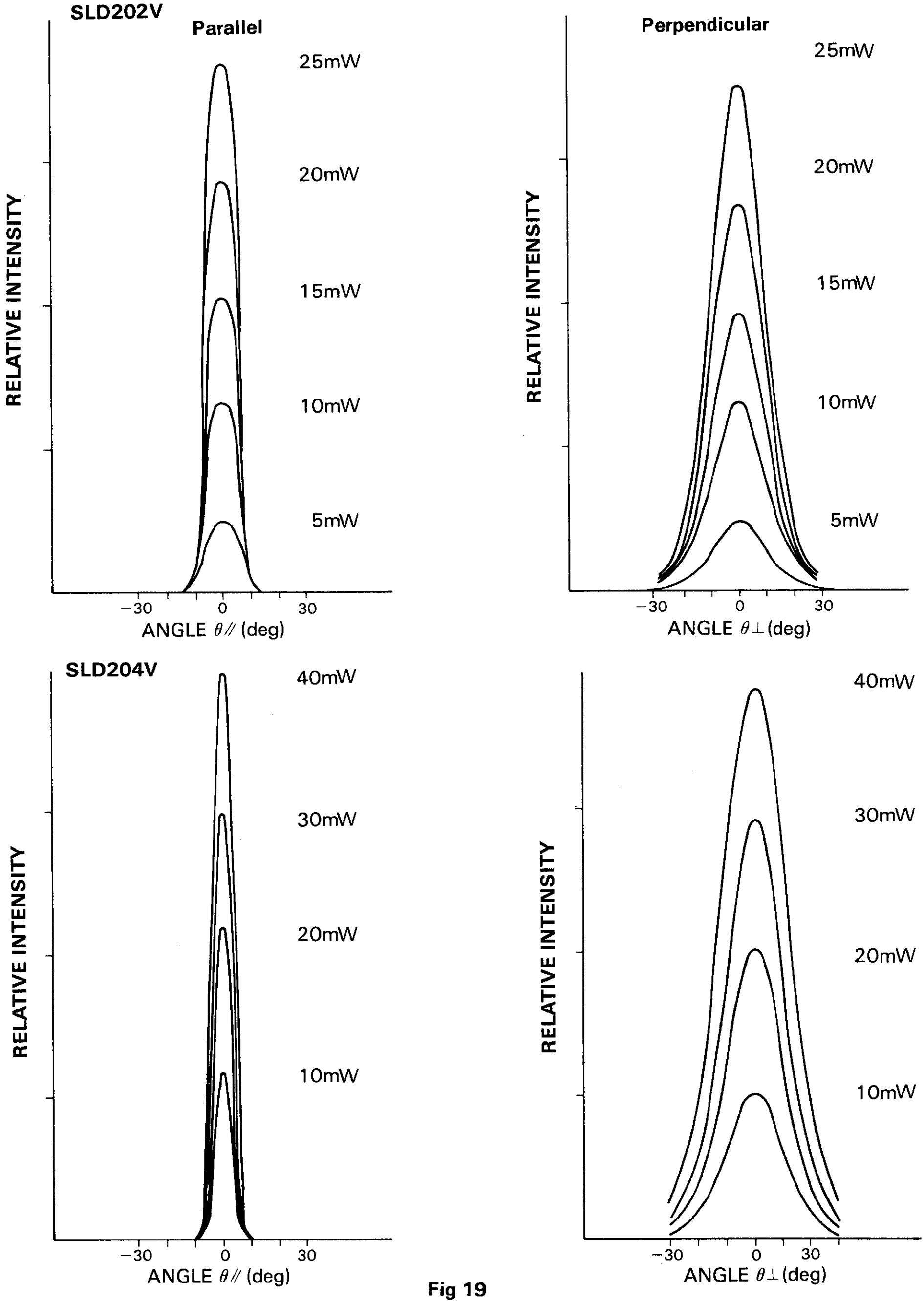


Fig 19

Polarization vs. Output Power

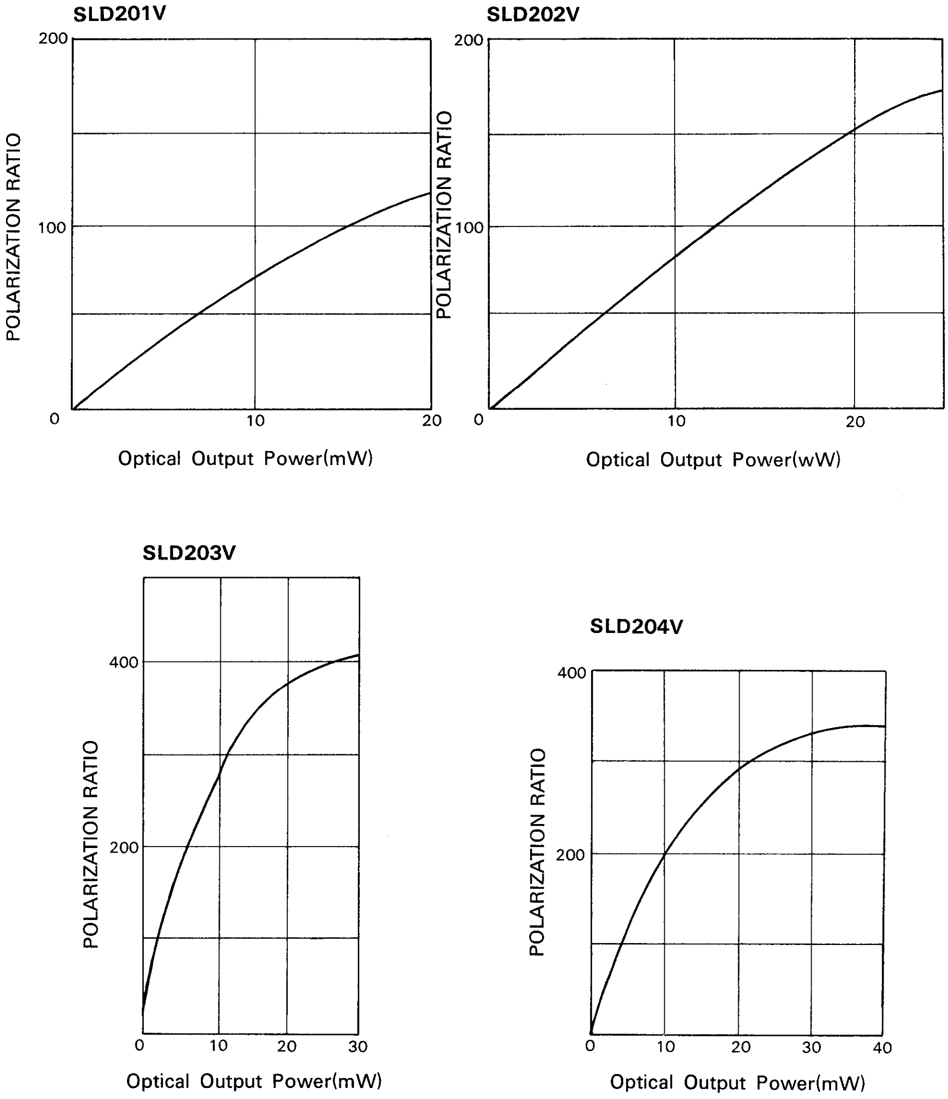


Fig 20

Astigmatism vs. Output Power

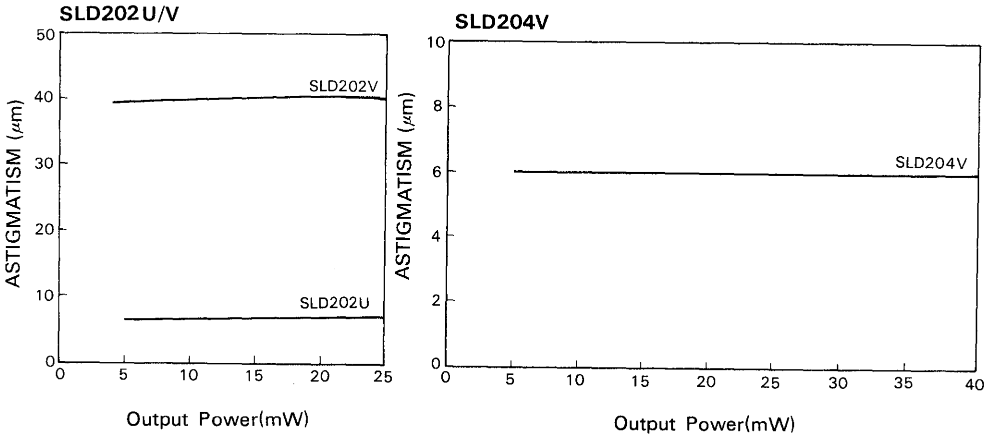


Fig 21

Monitor Current vs. Output Power

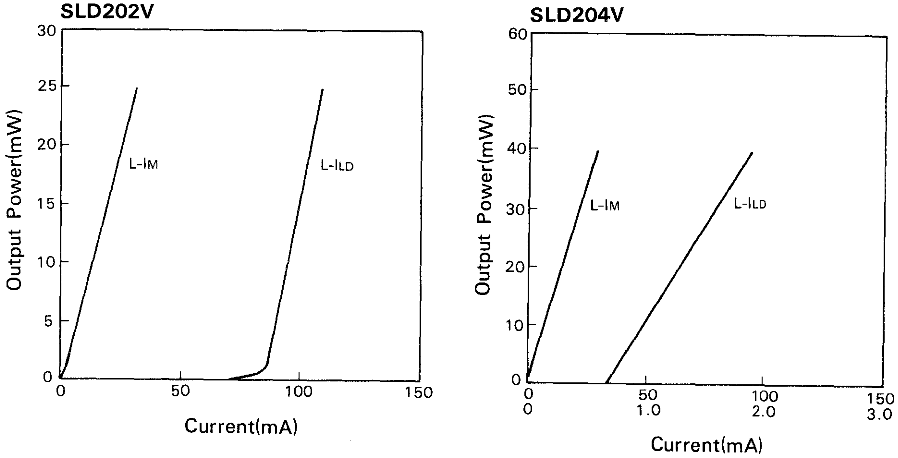


Fig 22

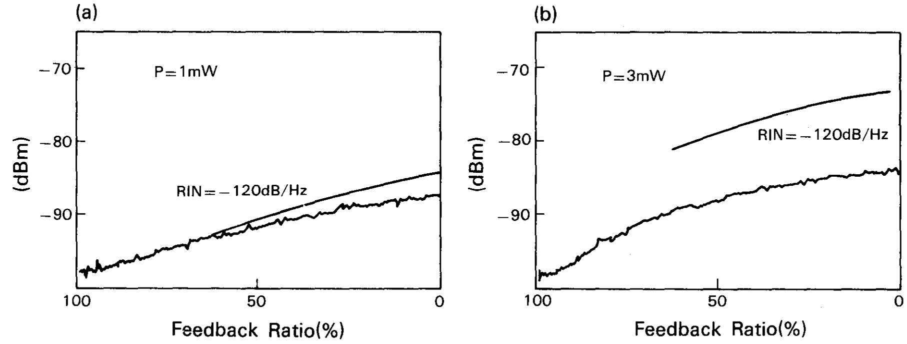
4-4) Signal-to-Noise Ratio (S/N)

The noise generated by a laser diode is a measure of the instability of the lasing action. One major cause of instability is mode-hopping noise,where the spectrum of the laser "hops" from one state to another due to the effect of its own light beam going back into the laser cavity after bouncing back from a reflecting surface.This is a major problem with optical disc applications such as Compact Discs,and especially with longitudinally single-mode index-guided lasers which are very susceptible to mode-hopping.With gain-guided lasers,such as the SLD100 series,the problem is not significant.

The relative intensity noise,or RIN,is the standard parameter measured to evaluate the signal-to-noise ratio of a laser diode.The RIN noise is a function of the amount of reflected light,the chip temperature,the operating power level,and other factors.

Relative Intensity Noise (RIN) vs. Returned Light Power Ratio

SLD101U



RBW = 10 KHz
CF = 750 KHz
TEMP= 24°C
L = 42 mm

SLD202U/V

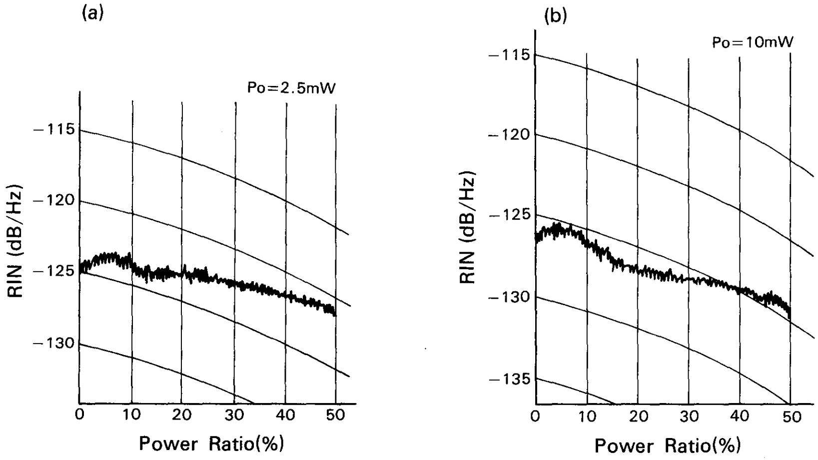
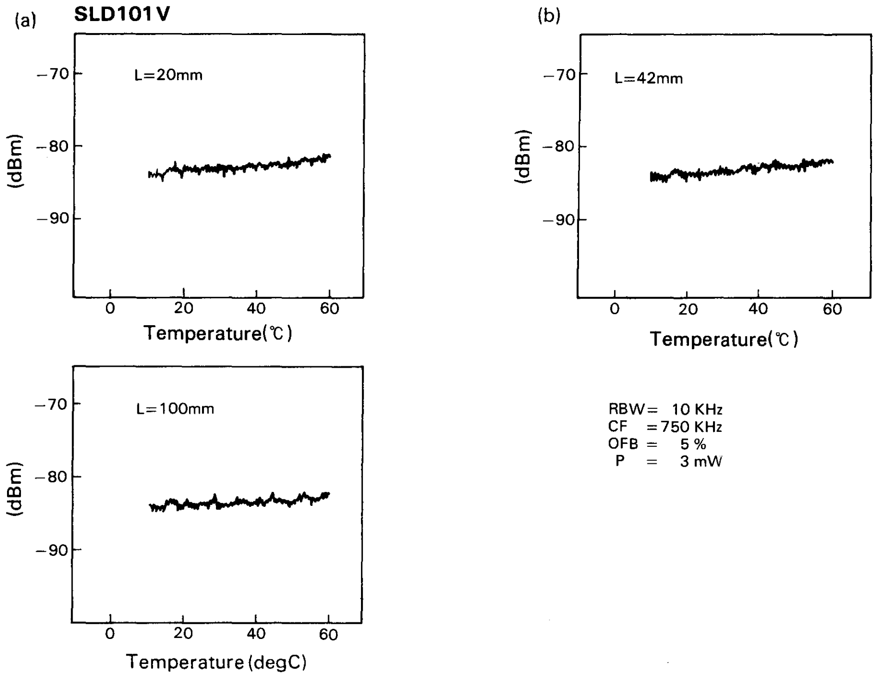


Fig 23

Relative Intensity Noise (RIN) vs. Temperature



RBW = 10 KHz
CF = 750 KHz
OFB = 5 %
P = 3 mW

Fig24

SLD201V

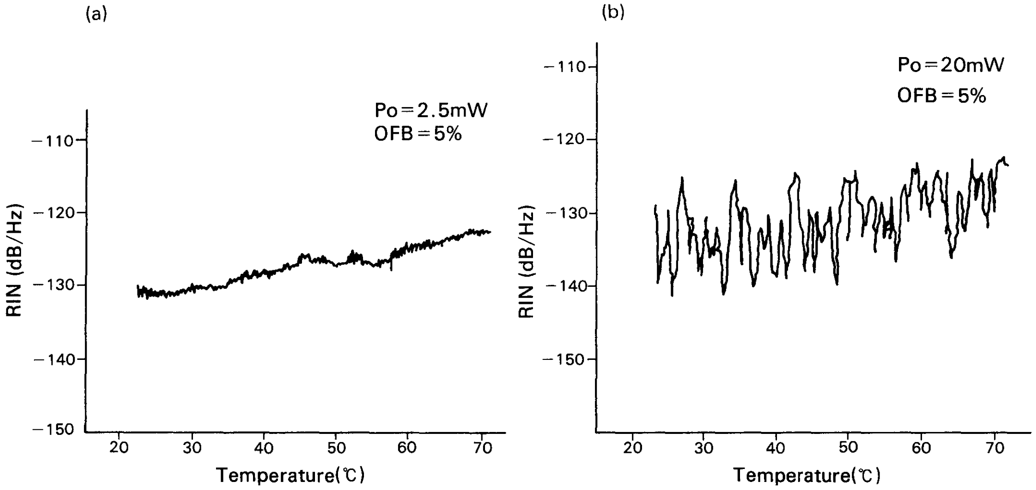


Fig 25

4-5) Drive Circuitry

A properly designed power supply is essential to ensure the laser diode's correct and safe operation.Poorly designed drive circuits run the risk of damaging the laser,in turn shortening the laser's life or even destroying it.

Laser diodes are generaly operated in either of two modes:

a) Constant Current (Automatic Current Control, ACC) Mode
b) Constant Output Power (Automatic Power Control, APC) Mode

Basically, a good power supply should have the following characteristics :

a) Filter circuitry to suppress transients during power-up and power-down
b) Low noise (no ripples, RF noise, etc.)
c) Automatic shutoff mechanism to avert thermal runaway and other potential failures
d) High resolution and stability of current control
e) Modulation capability

Fig 26 and 27 show typical circuit examples for driving a high-power (SLD200/300 series) diode.

Automatic Power Control (APC) Circuit

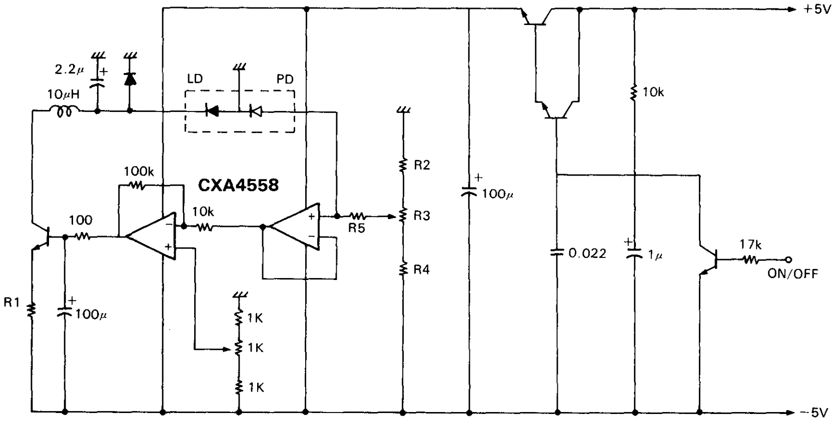


Fig26

Automatic Current Control (ACC) Circuit

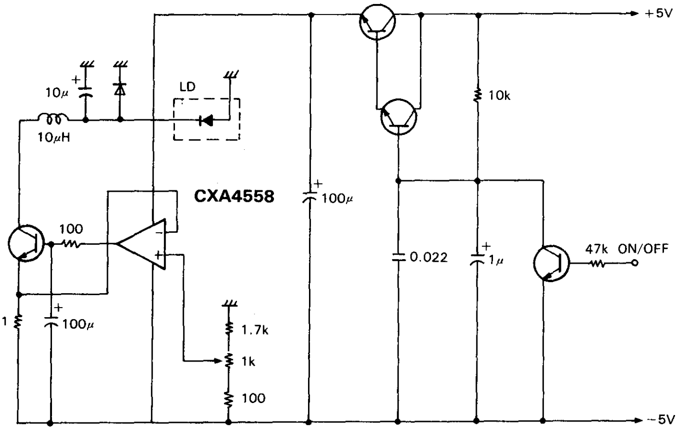


Fig27

4-6) Frequency Response

The output beam of a laser diode can be directly modulated at high frequencies by modulating the drive current.The modulating current signal is normally superimposed on a DC bias current which is set at just above the laser's threshold level to obtain the best high frequency response.

Pulse Response Measurement Set-up

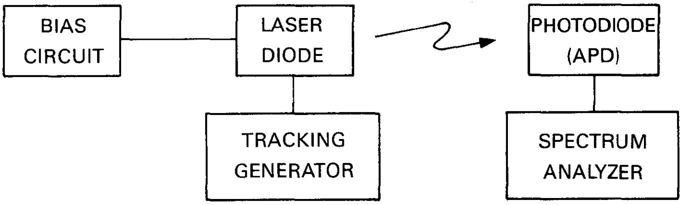


Fig28

Frequency Response Characteristics

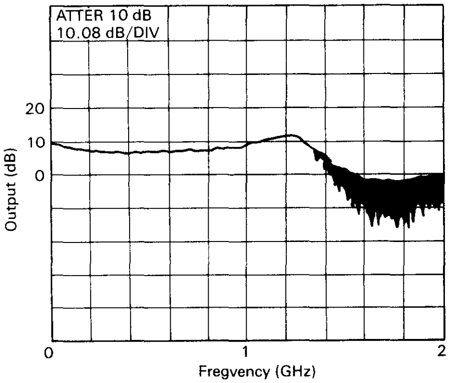
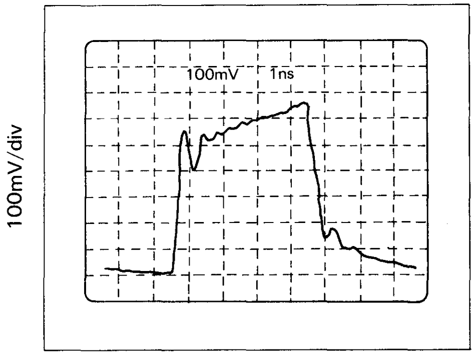


Fig29

Square-wave Response Waveform



1ns/div

Fig30

4-7) Handling and Storage

Laser diodes are extremely sensitive to electrostatic discharge.Devices should always be stored or shipped in conductive (anti-static) bags or boxes to prevent charge build-up.All workbenches,equipment and human operators must be properly grounded when handling the laser diodes.Even a momentary surge of static electricity will instantaneously destroy the laser.

Dust,fingerprints,and other foreign material on the glass cap of the package will degrade the laser's beam quality due to interference, diffraction,and absorption.

Below is a list of standard precautions to be taken when working with the laser diodes:

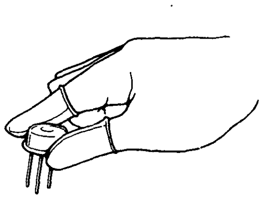
Ground all objects: workbench,soldering iron,electrical equipment.

Ground human operator-Wear grounded wrist-wrap, anti-static shoes, and anti-static gown.

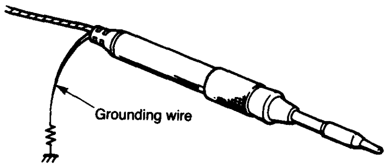
Wear finger sacks to avoid fingerprints on the laser glass cap.

Do not use air nippers,since they generate static electricity.

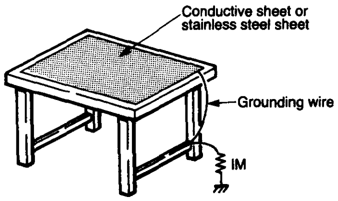
Keep temperature of soldering iron below 320℃, and soldering time short.Never solder the laser directly to the heat sink.



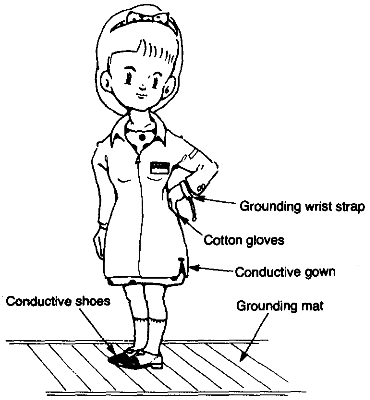
Handling



Soldering Iron



Workbench



Clothing

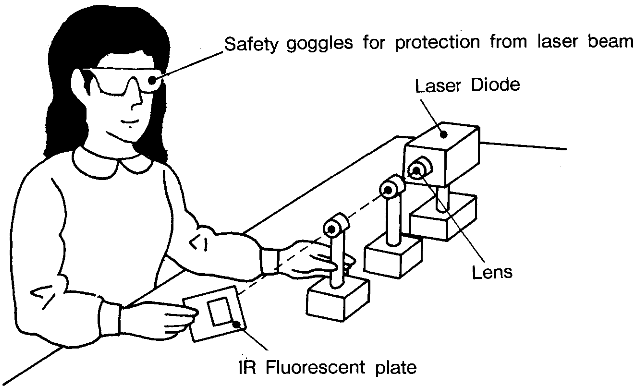
Fig31

4-8) Safety Considerations

The optical output of laser diodes ranges from several milliwatts to one watt,but the optical density of the laser beam at the facet approaches 1 Megawatt/centimeter.

Unlike gas lasers,semiconductor lasers have relatively divergent beams.Therefore,the beam of an uncollimated laser diode is fairly safe at a distance.As a general rule,however, it is best to NEVER LOOK into a laser beam under any conditions.When viewing a laser beam,safety goggles (which transmit visible but block infrared) are recommended.Also,the use of IR scopes,IR cameras,and fluorescent plates is also convenient for monitoring the laser beam safely.

Laser diodes are ranked as Class IIIB and IV products by the U.S.Depertment of Health, Education and Welfare.Class IIIB covers laser diodes up to 500mW in optical output.1W lasers fall in the Class IV category.



Safety equipment manufacturers:

Eastman Kodak-IR scopes,IR fluorescent plates

FJW Industries-Find-R-Scope

Yamamoto Kodak-Goggles

4-9) Thermal Dissipation Considerations

High power laser diodes obviously require proper heat dissipation measures to maintain the chip temperature within rated levels and assure a long lifetime.Since the optical conversion efficiency of a laser diode is under 25%, a substantial portion of the DC power is dissipated as heat from the package.

Sony's medium and high power lasers are currently mounted in the 9-millimeter "V" package and the TO-3 fin-type "W" package. The two packages have the following approximate thermal resistances from the laser cavity to the package's external surface (including the laser chip's thermal resistance). The values have been measured by means of the standard delta-Vf method.

V package:42°C/W
W package:33°C/W

Shown below is a standard method of mounting a "V" package between two heat-sinking blocks.Application of silicon grease or other material to enhance the thermal contact between the package and heat sink is strongly recommended.

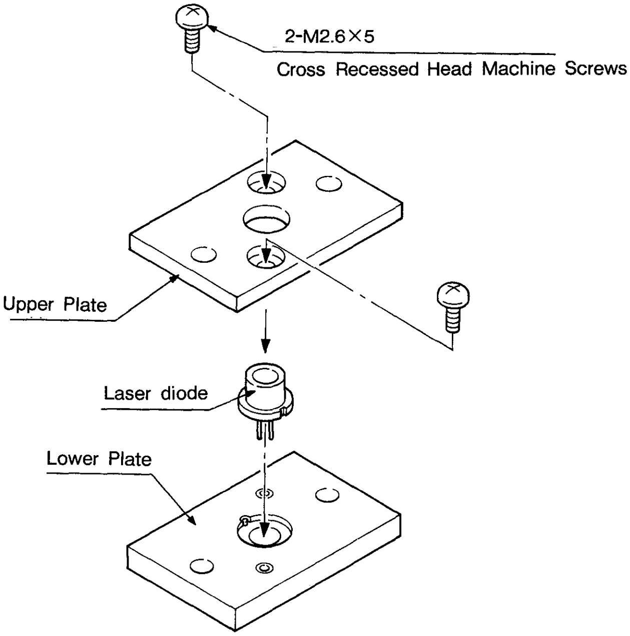


Fig 33

Since most of the heat dissipated from the laser chip is drained from the underside of the package,make sure that the heat sink makes good contact with the bottom flange of the package.

In addition to the "V" and "W" packages, new versions are expected to be offered in the near furture,including packages with integrated thermo-electric (TE) cooler elements. Consult the local Sony representative for details.

4-10) Compact Disc Application

The Compact Disc (CD) format is the worldwide industry standard for digital audio discs. Sony is a leading manufacturer of Compact Discs and Compact Disc players,and the low noise SLD100 series laser diodes are used in this application.Shown below is a typical example of a 3-beam optical pickup system for reading the PCM encoded audio signals from the disc's surface.This 3-beam system not only extracts the digital signals recorded in the disc,but is also capable of generating its own tracking and focusing error information from the signals themselves,and perform its own correction by means of servo control.

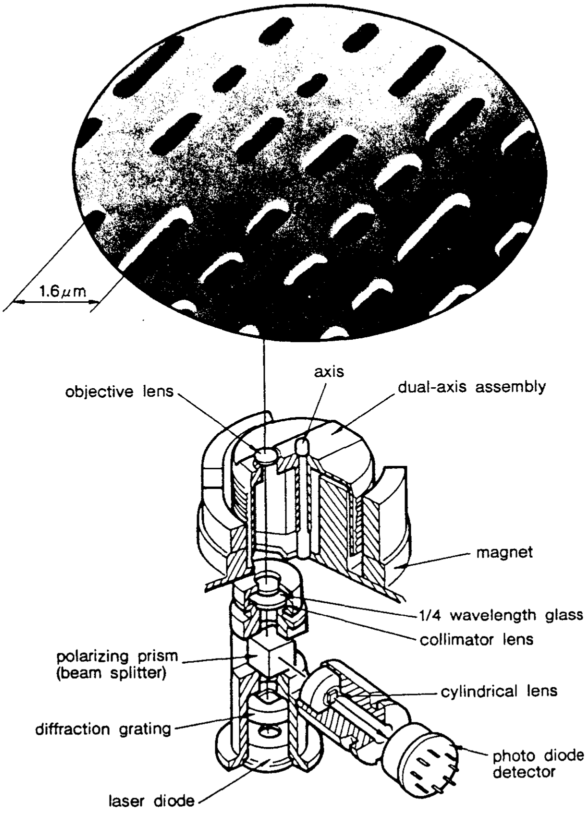
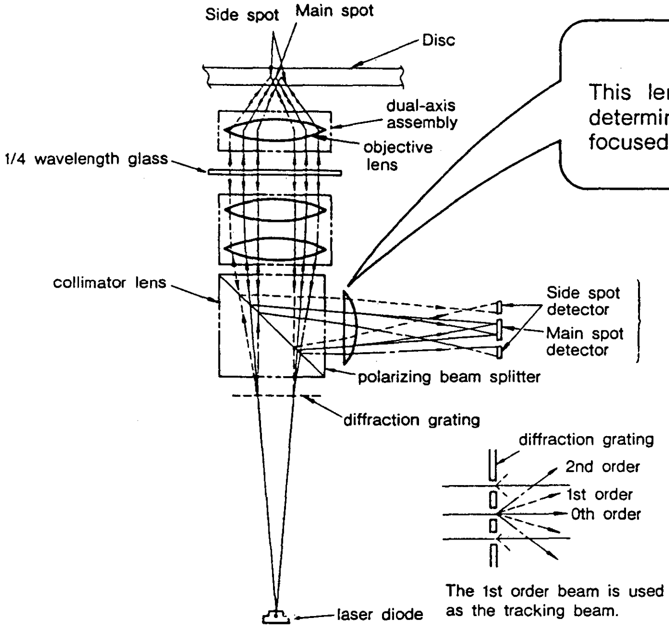


Fig. 34

The **collimator lens** transforms the laser light into a parallel beam, while the **1/4 wavelength glass plate** converts the beam's linear polarization into circular polarization. The beam is then focused using the **objective lens** onto the pits embedded under the disc's surface, where it is reflected back wherever a pit exists. The polarizing prism separates the outgoing and reflected beams by using the different beam polarizations.



The 1st order beam is used as the tracking beam.

Cylindrical Lens

This lens together with the 4 detectors determine whether the beam is precisely focused onto the disc or not.

Focusing detector

The four detectors determine the focus by noting the beam shape.

Tracking detector

The sidespot signal is used to control the tracking servo mechanism for correct beam tracking over the microscopic pits.

Fig. 35

4-11) MOCVD Epitaxial Technology

Sony is a world leader of MOCVD technology,and all laser diodes fabricated by Sony use this epitaxial growth method.A comparison between the three major competing technologies is made in the table below.The major advantages of MOCVD are the high productivity, controllability,and abruptness of the AlGaAS/GaAs heterojunction interface.

Since the start of large-scale production of laser diodes for Compact Discs in 1983, the high reliability of Sony's MOCVD lasers has been demonstrated and firmly established. This same crystal growth technology is also currently applied in Sony's super low noise microwave HEMTs and other heterojunction devices.

Item	LPE	MBE	MOCVD
Interface Abruptness	Gentle (100 Å or more)	Abrupt (several Å)	Abrupt (several Å)
Thickness Controllability	Difficult	Very good	Very good
Actual production	Yes	Not yet	Started by SONY
Productivity and uniformity	Poor (small wafer)	Fair (small wafer)	Very good
Reliability	Established	Not established	Established
Major Devices in production and under development	Laser diode*	HEMT HBT	Laser diode* HEMT* HBT

LPE : Liquid Phase Epitaxy

MBE : Molecular Beam Epitaxy

MOCVD : Metal Organic Chemical Vapor Deposition

*Mass Production

5) Gallium arsenide FETs

(1) Notes on transportation and storage

- Be sure to use a MOS pack or conductive case for transportation and storage.
- Grounding the shelf used to accomodate such cases is recommended.

(2) Notes on handling

- Be sure to use cotton gloves and finger sacks. Do not use bare hands to touch the device leads.
- Do not wear static prone clothing such as nylon gowns. Wear conductive gowns and shoes.
- Use a wrist band and ground it.
- Place a conductive sheet, stainless steel, or aluminum plate on the work bench and ground it. Equipment and facilities must also be grounded.
- When humidity is low, static electricity can easily build up. Be sure to work in a high humidity environment.

(3) Notes on incorporating in circuits

- Mount lasers to the substrate, as much as possible, at the end after all other components have been mounted.
- Use a leak proof soldering iron and be sure to ground it.
- Solder within 5 seconds at a temperature below 250°C.
- When using belt conveyors or other equipment make sure they are not charged with static electricity.
- When storing a completed circuit, be sure to place it in a conductive case and store on a grounded shelf.

(4) Other notes

- Defective parts must be collected in a waste container and disposed of properly.
- Do not place devices in acid or alkaline solutions.

6) Magnetoresistance Elements

(1) Transportation and storage

- Be sure not to allow any vibrations, impacts or mechanical stress to the device.
- Use a container resistant to static electricity.

Bending of lead wires

- Be careful not to exert stress between the mold resin and lead wires. When bending leads, use of a fixed mold is recommended.
- Do not bend repeatedly.

(2) Substrate packaging

- A solder flux such as Rosin flux with minimal corrosiveness and high insulation characteristics is recommended.
- Be sure to solder lead wires at a temperature below 260°C within 10 seconds.

(3) Holder fitting

- Be careful not to exert mechanical stress on devices, when using adhesives.

Variable Capacitance Diodes

1) Variable Capacitance Diodes

Silicon Epitaxial Planer

Type	Application	Feature	Page
1T32/T/A/AT	UHF/VHF tuning	Small package $\Delta C \leqq 3\%$ (type A is 2%)	53
1T362	UHF/VHF tuning	Super minimold package of 1T32, $\Delta C \leqq 3\%$	56
1T33/T/A/AT	CATV tuning	Small package $\Delta C \leqq 3\%$ (type A is 2%)	59
1T33C/1T33CT	CATV tuning	Small package $\Delta C \leqq 2\%$	62
1T359	FM/TV tuning	Small package $\Delta C \leqq 3\%$	65
1T363	CATV tuning	Super minimold package of 1T33C, $\Delta C \leqq 3\%$	67

Note) ΔC: Maximum capacitance deviation for same rank.

SONY

1T32/1T32T 1T32A/1T32AT

Silicon Variable Capacitance Diode

Description

The 1T32/1T32T/1T32A/1T32AT is a variable capacitance diode designed for use in electric tuning for UHF, VHF and TV tuner, and AFT which make their packages more compact so as to match tuner miniaturization easily, keeping excellent characteristics of former 1T25 type.

Features

- Compact package

• Low serial resistance	0.52 Ω	Typ.	(f = 470 MHz)
• Large capacitance ratio	6.5	Typ.	(C_2/C_{25})
• Small leakage current	10 nA	Max.	(V_R = 28V)

- 1T32T/1T32AT is for taping

Structure

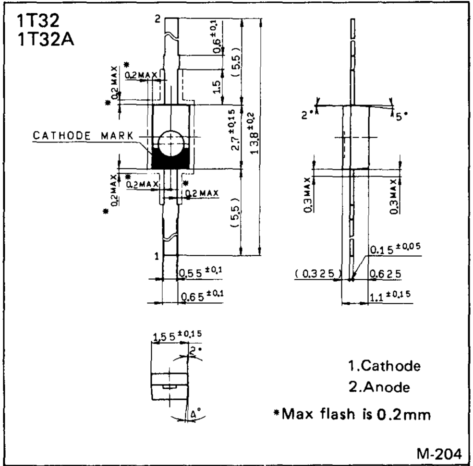
Silicon epitaxial planar type diode

Applications

Electric tuning for UHF, VHF or TV tuner, or AFT

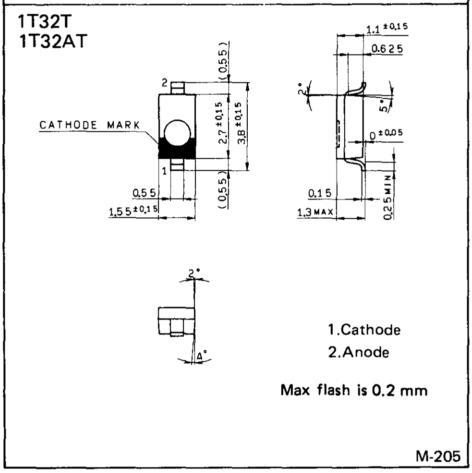
Package Outline

Unit: mm



1.Cathode
2.Anode
*Max flash is 0.2mm

M-204



1.Cathode
2.Anode
Max flash is 0.2 mm

M-205

Absolute Maximum Ratings (Ta = 25°C)

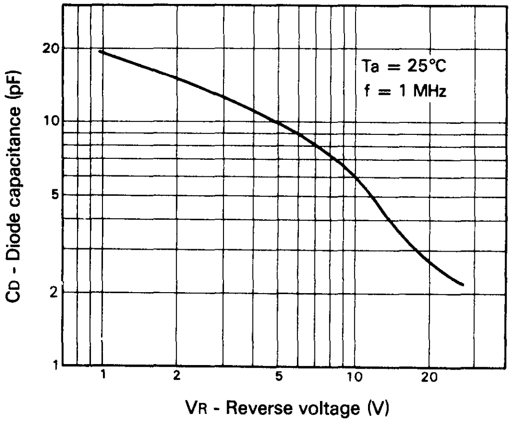
• Reverse voltage	V_R	30	V	
• Peak reverse voltage	V_{RM}	35	V	($R_L \geqq 10\,k\Omega$)
• Operating temperature	Topr	85	°C	
• Storage temperature	Tstg	−30 to +120	°C	

Electrical Characteristics

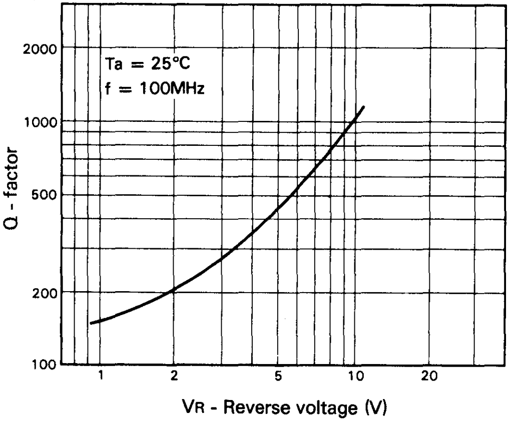
Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	V_R = 28V			10	nA
Diode capacitance	C_2	V_R = 2V, f = 1 MHz	14.01	15.00	16.33	pF
	C_{25}	V_R = 25V, f = 1 MHz	2.10	2.27	2.39	pF
Serial resistance	r_s	C_D = 14 pF, f = 470 MHz		0.52	0.6	Ω
Maximum-capacitance deviation in the Same ranking*	ΔC	V_R = 2 to 25V			3 (1T32/1T32T) 2 (1T32A/1T32AT)	%

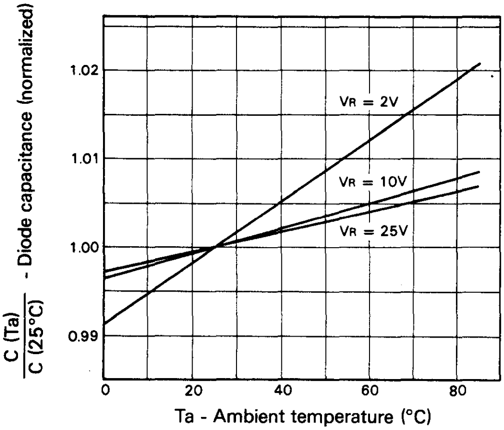
*Note) Applied only to tuning.



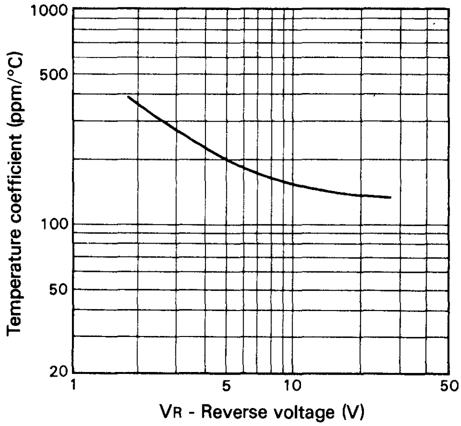
Diode capacitance vs. Reverse voltage



Q - factor vs. Reverse voltage

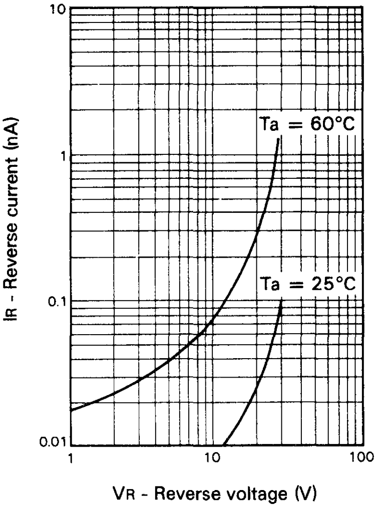


Diode capacitance vs. Ambient temperature

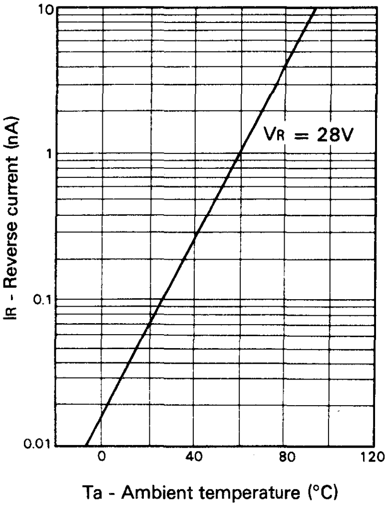


Temperature coefficient of the diode capacitanc

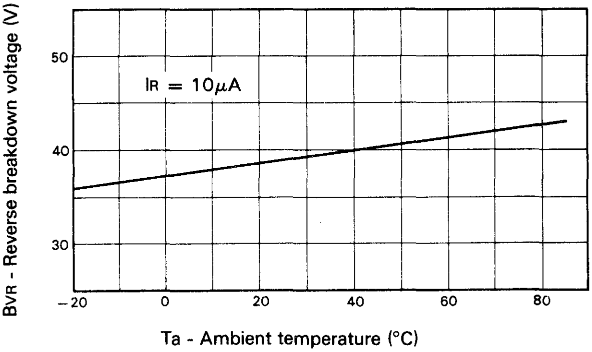
Reverse current vs. Reverse voltage



Reverse current vs. Ambient temperature



Reverse breakdown voltage vs. Ambient temperature



SONY® **1T362**

Silicon Variable Capacitance Diode

Description

The 1T362 is a variable capacitance diode designed for electronic tuning UHF, VHF TV tuners and AFT circuits. A miniature package has been adopted to allow tuner miniaturization, while maintaining the same superior features of 1T32.

Features

- Super miniature package
- Low series resistance 0.65Ω Max. (f=470 MHz)
- Large capacitance ratio 6.5 Typ. (C2/C25)
- Small leakage current 10 nA Max. (VR=28V)
- Maximum capacitance deviation 3% Max.

Structure

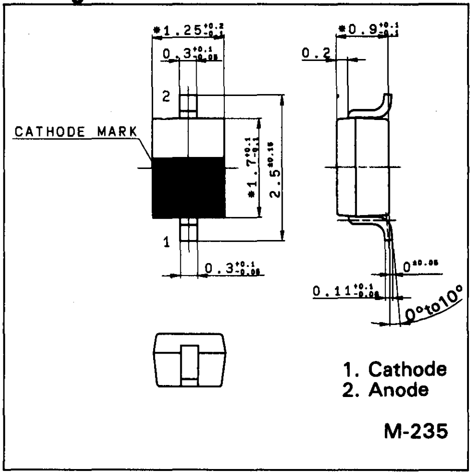
Silicon epitaxial planar type diode

Application

Electronic tuning for UHF, VHF or TV tuner, or AFT

Package Outline

Unit: mm



Note) *Dimension does not include resin

Absolute Maximum Ratings (Ta=25°C)

• Reverse voltage	VR	30	V	
• Peak reverse voltage	VRM	35	V	(RL≧10 kΩ)
• Operating temperature	Topr	85	°C	
• Storage temperature	Tstg	–55 to +150	°C	

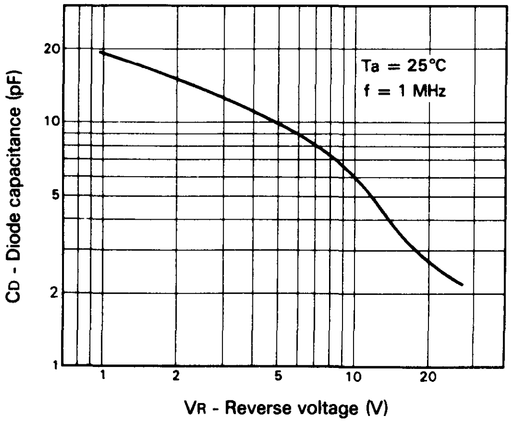
Electrical Characteristics

Ta = 25°C

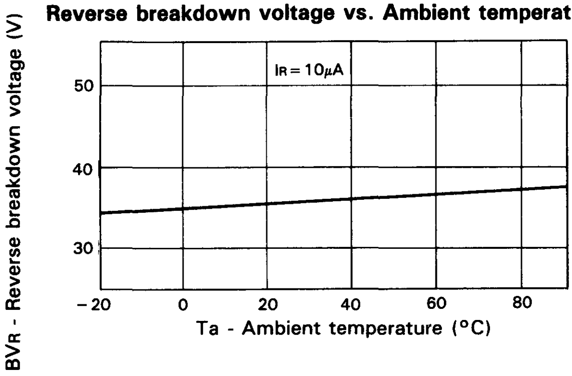
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	$V_R = 28V$			10	nA
Diode capacitance	C_2	$V_R = 2V$, f = 1 MHz	14.01	15.00	16.33	pF
	C_{25}	$V_R = 25V$, f = 1 MHz	2.10	2.27	2.39	pF
Series resistance	rs	$C_D = 14pF$, f = 470 MHz		0.57	0.65	Ω
Maximum-capacitance deviation in the same ranking*	ΔC	$V_R = 1$ to 28V, f = 1 MHz			3	%

***Note)** Applied only to tuning.

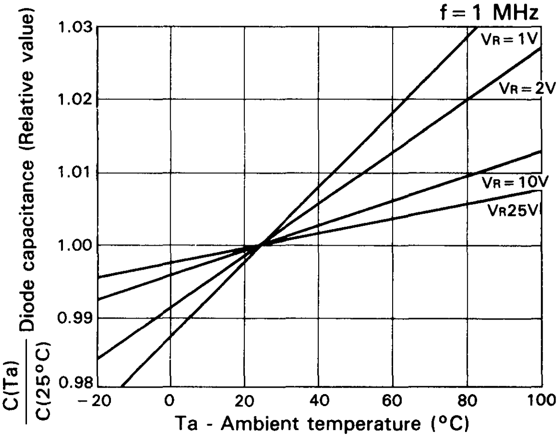
Diode capacitance vs. Reverse voltage



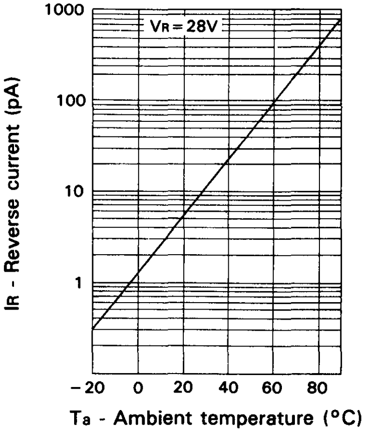
Reverse breakdown voltage vs. Ambient temperature



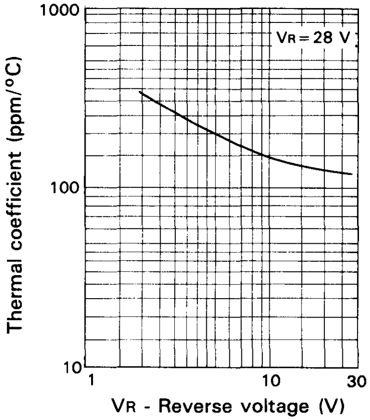
Diode capcitance vs. Ambient temperature



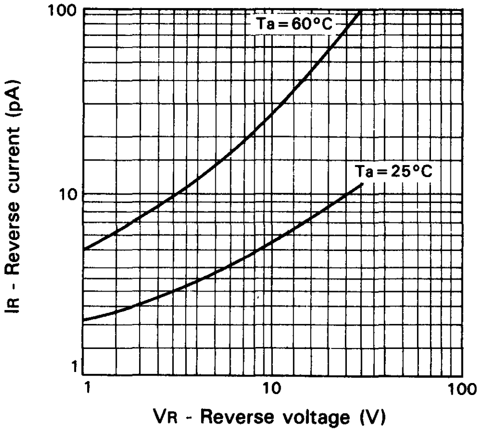
Reverse current vs. Ambient temperature



Thermal coefficient of diode capacitance



Reverse current vs. Reverse voltage



SONY®

1T33/1T33T
1T33A/1T33AT

Silicon Variable Capacitance Diode

Description

The 1T33/1T33T/1T33A/1T33AT is a variable capacitance diode designed for use in electric tuning for CATV tuner which make their packages more compact so as to match tuner minituarization easily, keeping excellent characteristics of former 1T31 type.

Features

- Compact package
- Low serial resistance 0.8Ω Typ. (f = 470 MHz)
- Large capacitance ratio 10 Min. (C 2/C 25)
- Small leakage current 10 nA Max. (VR = 28V)
- 1T33T/1T33AT is for taping.

Structure

Silicon epitaxial planar type diode

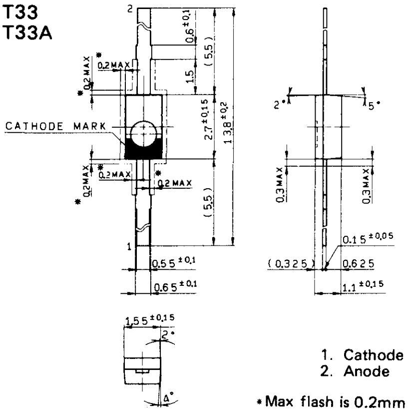
Application

Electric tuning for TV or CATV

Package Outline

Unit: mm

1T33
1T33A

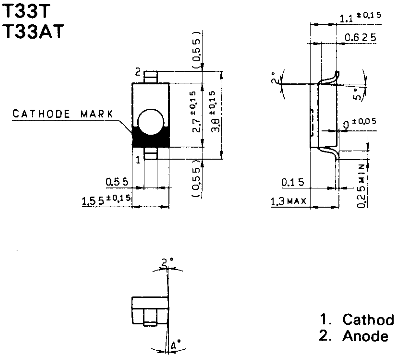


1. Cathode
2. Anode

*Max flash is 0.2mm

M-204

1T33T
1T33AT



1. Cathode
2. Anode

Max flash is 0.2mm

M-205

Absolute Maximum Ratings (Ta = 25°C)

• Reverse voltage	VR	30	V	
• Peak reverse voltage	VRM	35	V	(RL ≧ 10 kΩ)
• Operating temperature	Topr	85	°C	
• Storage temperature	Tstg	−30 to +120	°C	

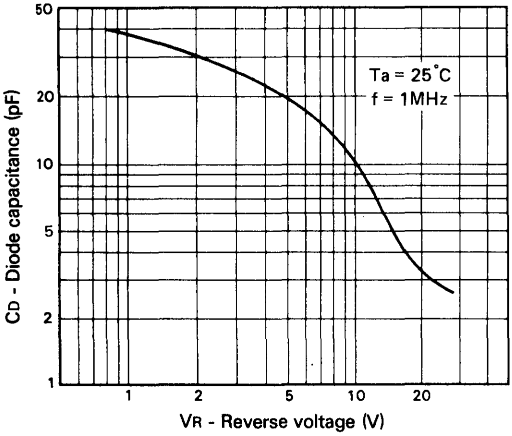
Electrical Characteristics

Ta = 25°C

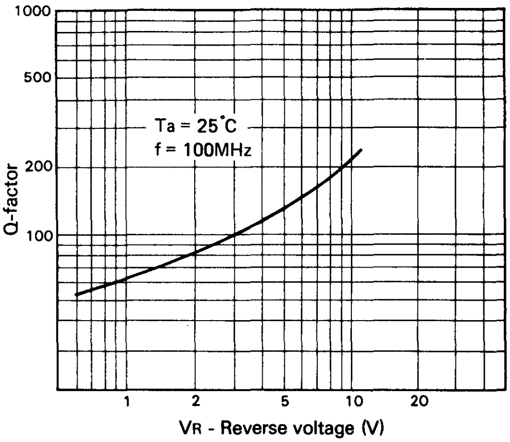
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	V_R = 28V			10	nA
Diode capacitance	C_2	V_R = 2V, f = 1 MHz	27.19		32.03	pF
	C_{25}	V_R = 25V, f = 1 MHz	2.71		3.04	pF
Serial resistance	r_s	C_D = 14pF, f = 470 MHz		0.7	0.8	Ω
Maximum-capacitance deviation in the same ranking•	ΔC	V_R = 2 to 25V, f = 1 MHz			3 (1T33/1T33T) 2 (1T33A/1T33AT)	%

•Note) Applied only to tuning.

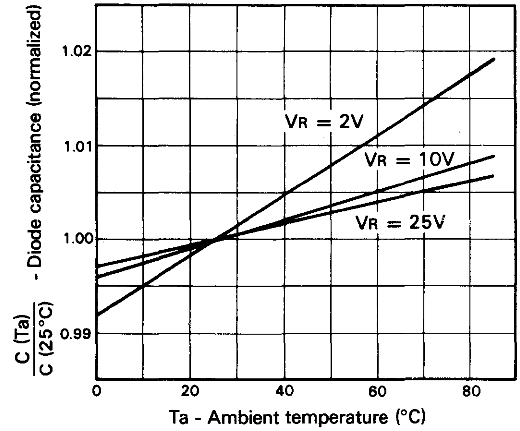
Diode capacitance vs. Reverse voltage



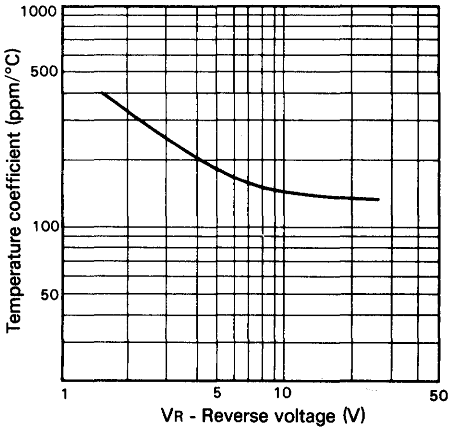
Q-factor vs. Reverse voltage



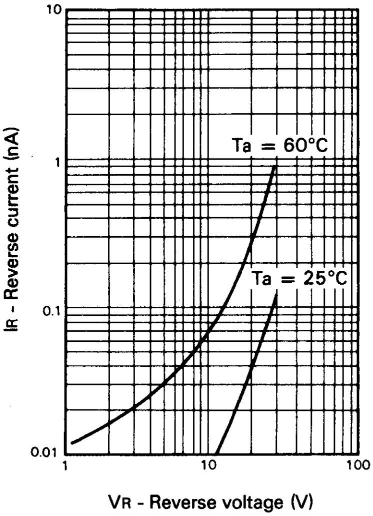
Diode capacitance vs. Ambient temperature



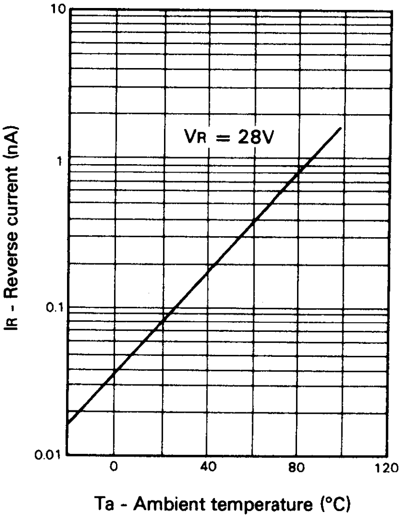
Temperature coefficient of the diode capacitance



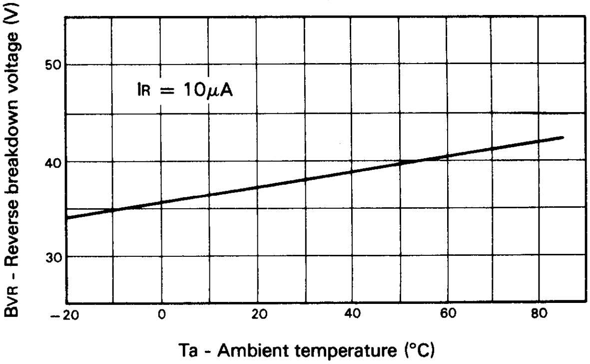
Reverse current vs. Reverse voltage



Reverse current vs. Ambient temperature



Reverse breakdown voltage vs. Ambient temperature



SONY.

1T33C/1T33CT

Silicon Variable Capacitance Diode

Description

The IT33C/IT33CT is designed for CATV tuner, these diodes easily cope with the trend for miniaturization. They combine low serial resist with large capacitance variation ratio and small capacitance variation rate n*.

$$* \left[n = -\frac{V\,dC}{C\,dV} \right]$$

Features

- Compact package
- Low serial resistance 0.65 Ω Typ. (f = 470 MHz)
- Large capacitance ratio 15 Typ. (C_1/C_{28})
- Small leakage current 10 nA Max. (V_R = 28 V)
- 1T33CT is for taping

Structure

Silicon epitaxial planar type diode

Application

Electronic tuning for TV or CATV tuner

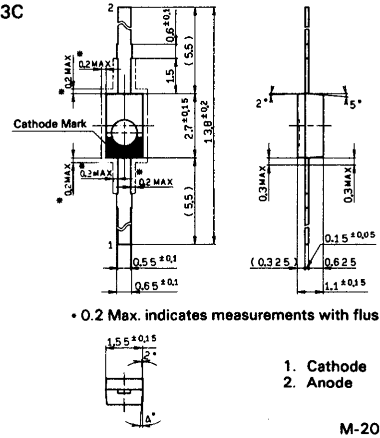
Absolute Maximum Ratings (Ta = 25°C)

• Reverse voltage	V_R	30	V
• Peak reverse voltage	V_{RM}	35 ($R_L \geqq 10\,k\Omega$)	V
• Operating temperature	Topr	85	°C
• Storage temperature	Tstg	−55 to +150	°C

Package Outline

Unit: mm

1T33C

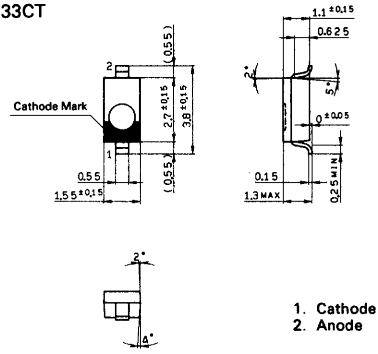


• 0.2 Max. indicates measurements with flush.

1. Cathode
2. Anode

M-204

1T33CT



1. Cathode
2. Anode

Measurements with resin flush: 0.2 max.

M-205

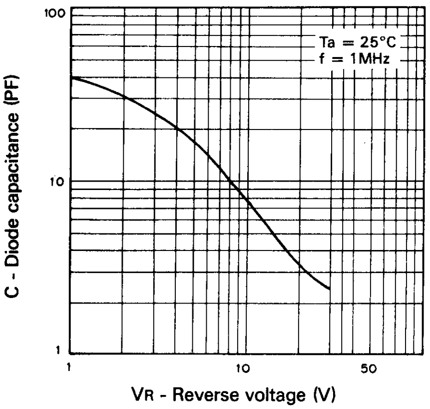
Electrical Characteristics

Ta = 25°C

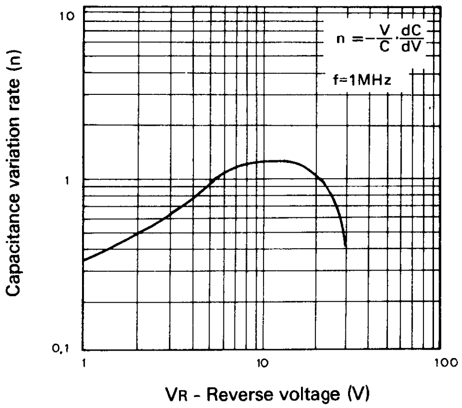
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	V_R = 28V			10	nA
Diode capacitance	C_1	V_R = 1V, f = 1 MHz	34.65	38.0	42.35	pF
	C_{28}	V_R = 28V, f = 1 MHz	2.361	2.515	2.754	pF
Capacitance ratio	C_1/C_{28}	f = 1 MHz	13.5	15		
Serial resistance	rs	C_D = 14 pF, f = 470 MHz		0.65	0.8	Ω
Maximum-capacitance deviation in the Same ranking *	ΔC	V_R = 1V to 28V, f = 1 MHz			2	%

* Note) Applied only for tuning.

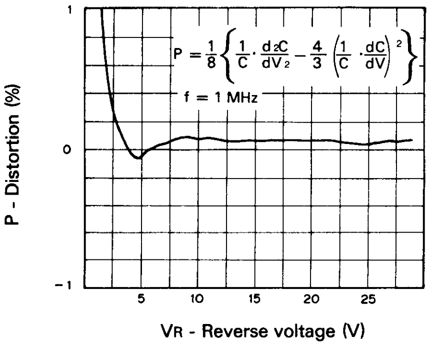
Diode capacitance vs. Reverse voltage



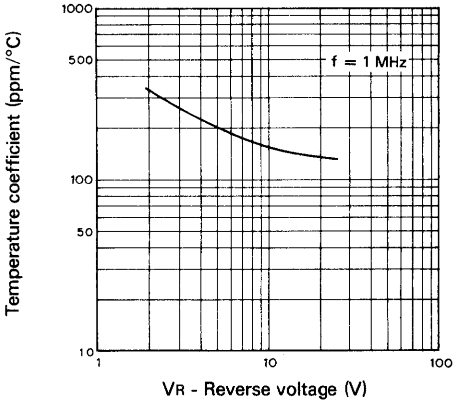
Capacitance variation rate vs. Reverse voltage



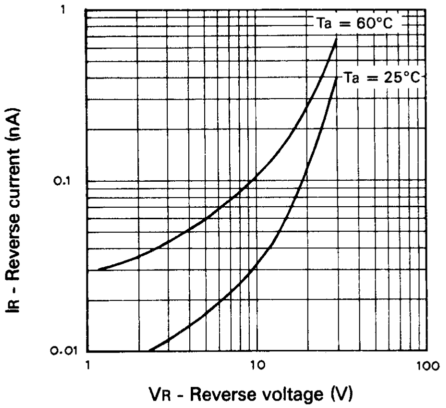
Distortion vs. Reverse voltage



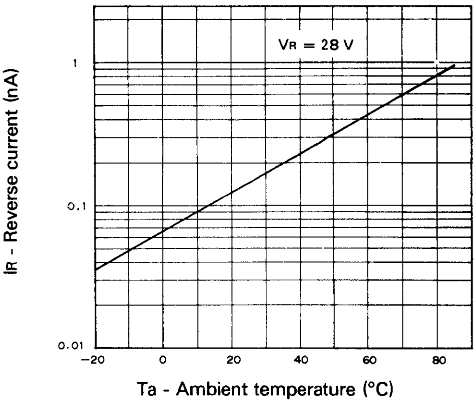
Temperature coefficient vs. Reverse voltage



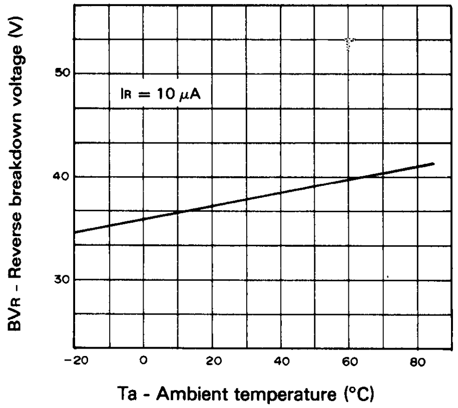
Reverse current vs. Reverse voltage



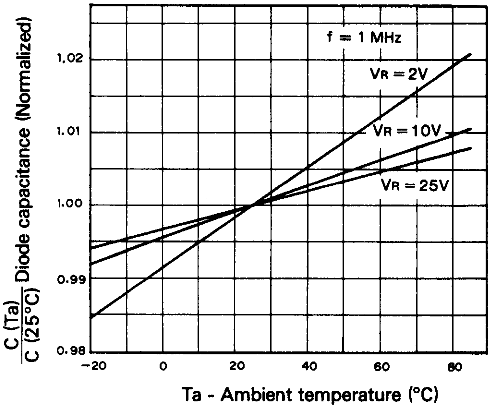
Reverse current vs. Ambient temperature



Reverse breakdown voltage vs. Ambient temperature



Diode capacitance vs. Ambient temperature



SONY® **1T359**

Silicon Variable Capacitance Diode

Description

The 1T359 is a variable capacitance diode for electronic tuning, designed for radio or TV tuners.

Features

- Compact package
- Low serial resistance 0.40Ω Max. (f = 470 MHz)
- Large capacitance ratio 6.5 Typ. (C_2/C_{25})
- Capacitance deviation in the same ranking within 3%

Structure

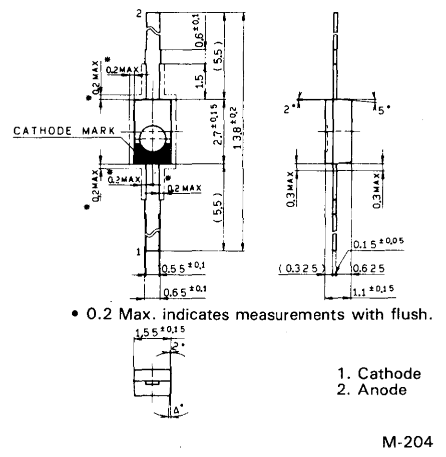
Silicon epitaxial planar type diode

Application

Electoronic tuning for Radio or TV tuner

Package Outline

Unit: mm



• 0.2 Max. indicates measurements with flush.

1. Cathode
2. Anode

M-204

Absolute Maximum Ratings ($T_a = 25°C$)

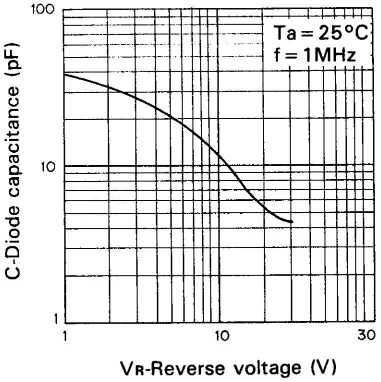
• Reverse voltage	V_R	30	V
• Peak reverse voltage	V_{RM}	35 ($R_L \geqq 10K\Omega$)	V
• Operating temperature	T_{opr}	85	°C
• Storage temperature	T_{stg}	−55 to +150	°C

Electrical Characteristics

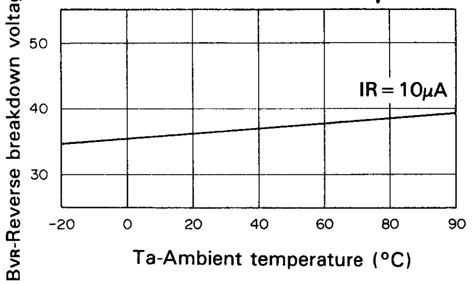
$T_a = 25°C$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	$V_R = 28$ V			20	nA
Diode capacitance	C_2	$V_R = 2$V, f = 1 MHz	26.37	29.50	33.05	pF
	C_{25}	$V_R = 25$ V, f = 1 MHz	4.030	4.400	4.807	pF
Capacitance ratio	C_2/C_{25}	f = 1 MHz		6.5		
Serial resistance	rs	$C_D = 14$ pF, f = 470 MHz		0.35	0.4	Ω
Capacitance deviation in the same ranking	ΔC	$V_R = 2$ to 25 V, f = 1 MHz			3	%

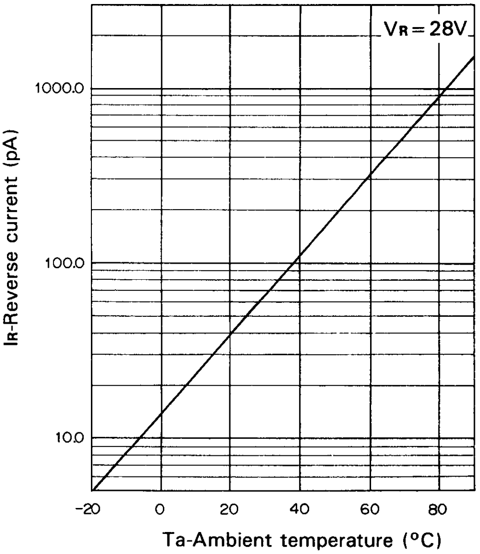
Diode capacitance vs. Reverse voltage



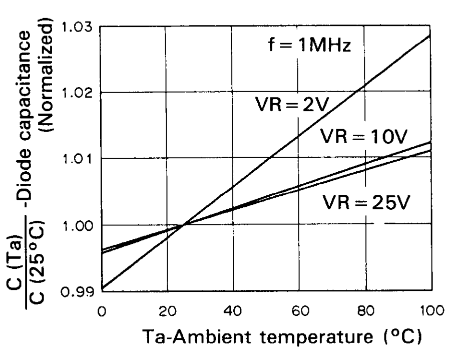
Reverse breakdown voltage vs. Ambient temperature



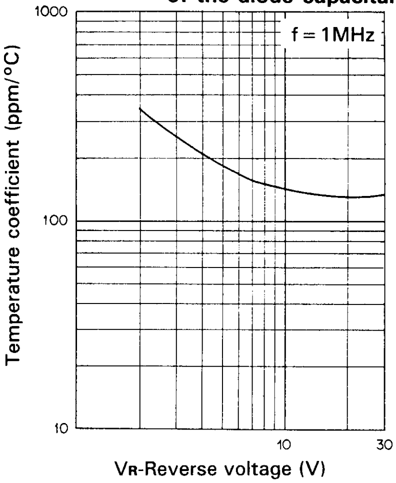
Reverse current vs. Ambient temperature



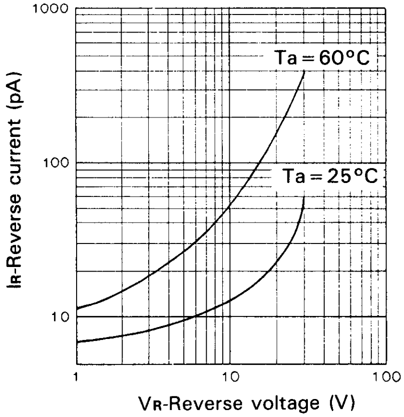
Diode capacitance vs. Ambient temperature



Temperature coefficient of the diode capacitance



Reverse current vs. Reverse voltage



SONY®

1T363

Silicon Variable Capacitance Diode

Description

The 1T363 is a variable capacitance diode designed for electronic tuning of CATV tuner. A miniature package has been adopted to allow tuner miniaturization, while maintaining the same superior features of 1T33C.

Features

- Super miniature package
- Low series resistance 0.80Ω Max. (f=470 MHz)
- Large capacitance ratio 15 Typ. (C_1/C_{28})
- Small leakage current 10 nA Max. (V_R=28V)
- Maximum capacitance deviation 3% Max.

Structure

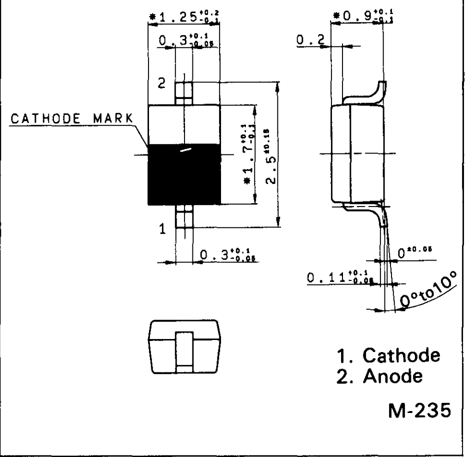
Silicon epitaxial planar type diode

Application

Electronic tuning for TV, CATV

Package Outline

Unit: mm



Note) *Dimension does not include resin

Absolute Maximum Ratings (Ta=25°C)

• Reverse voltage	V_R	30	V	
• Peak reverse voltage	V_{RM}	35	V	($R_L \geqq 10$ kΩ)
• Operating temperature	Topr	85	°C	
• Storage temperature	Tstg	−55 to +150	°C	

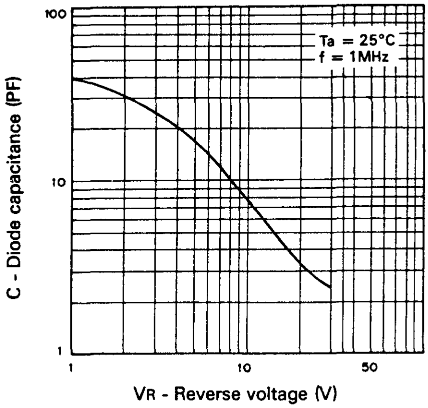
Electrical Characteristics

Ta = 25°C

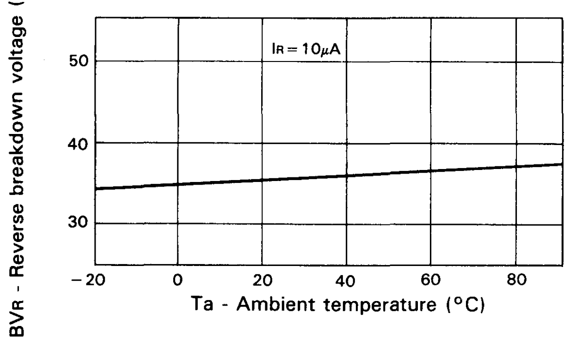
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Reverse current	I_R	V_R = 28V			10	nA
Diode capacitance	C_1	V_R = 1V, f = 1 MHz	34.65	38.00	42.35	pF
	C_{28}	V_R = 28V, f = 1 MHz	2.361	2.515	2.754	pF
Series resistance	r_s	C_D = 14pF, f = 470 MHz		0.75	0.80	Ω
Maximum-capacitance deviation in the same ranking*	ΔC	V_R = 1 to 28V, f = 1 MHz			3	%

***Note)** Applied only to tuning.

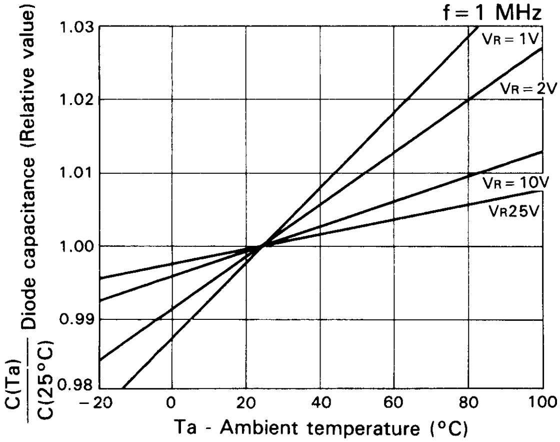
Diode capacitance vs. Reverse voltage



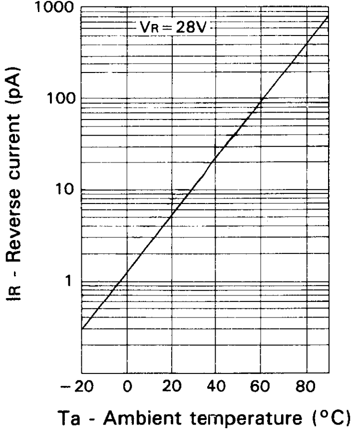
Reverse breakdown voltage vs. Ambient temperature



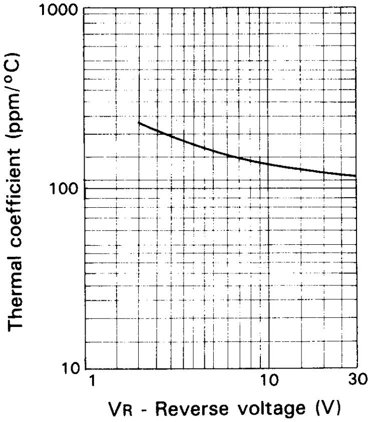
Diode capcitance vs. Ambient temperature



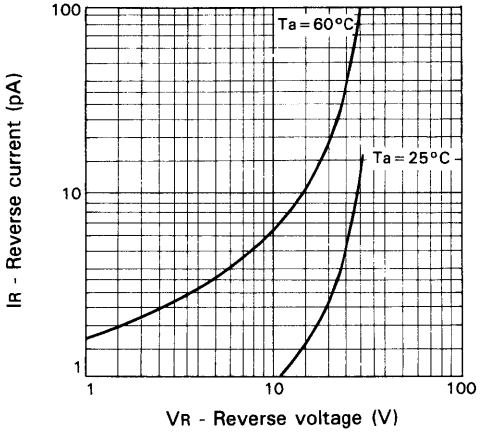
Reverse current vs. Ambient temperature



Thermal coefficient of diode capacitance



Reverse current vs. Reverse voltage



Laser Diodes

2) Laser Diodes

GaAlAs Visible Laser Diode

Type	Application	Feature	Page
SLD103U	CD/VD pick up light source	Small package (ϕ5.6mm), Low noise S/N=88dB Wavelength=780nm	74
SLD201U/V	Light source for optical disc and laser printer	High power output P_0=20mW, Low noise S/N=80dB Wavelength=780nm	78
SLD202U/V	Communications Solid-state laser pumping, Medical	High power output P_0=25mW, Low noise S/N=80dB Wavelength=820nm	81
SLD201U/V-3	Light source for optical disc and laser printer	High power output P_0=50mW, Low noise S/N=80dB Wavelength=820nm	84
SLD202U/V-3	Communications Solid-state laser pumping, Medical	High power output P_0=50mW, Low noise S/N=80dB Wavelength=820nm	87
SLD203V	Light source for optical disc and laser printer	High power output P_0=30mW, Single mode, Wavelength=780nm	90
SLD204V	Light source for optical disc and laser printer	High power output P_0=40mW, Single mode, Wavelength=820nm	92

2) Laser Diodes (continued)

GaAlAs Visible Laser Diode

Type	Application	Feature	Page
SLD301V	Communications Solid-state laser pumping, Medical	High power output P_0=100mW, Wavelength=770-840nm	94
SLD301W	Communications Solid-state laser pumping, Medical	High power output P_0=100mW, Wavelength=770-840nm	96
SLD302V	Communications Solid-state laser pumping, Medical	High power output P_0=200mW, Wavelength=770-840nm	98
SLD302W	Communications Solid-state laser pumping, Medical	High power output P_0=200mW, Wavelength=770-840nm	100
SLD303V	Communications Solid-state laser pumping, Medical	High power output P_0=500mW, Wavelength=770-840nm	102
SLD303W	Communications Solid-state laser pumping, Medical	High power output P_0=500mW, Wavelength=770-840nm	104
SLD304V	Communications Solid-state laser pumping, Medical	High power output P_0=1000mW, Wavelength=770-840nm	106
SLD304W	Communications Solid-state laser pumping, Medical	High power output P_0=1000mW, Wavelength=770-840nm	108

* SLD300 series will have other packages available during 1988:
S = Open heat sink
WT = TO-3 with a built-in TE cooler
X = Flat
XT = Flat with a built-in TE cooler

SONY® SLD103U

GaAlAs Laser Diode

Description

SLD103U is a GaAlAs double hetero-type low-noise visible laser. Compared with conventional laser diodes, the package size (ϕ5.6 mm) is 1/5 in volumetric ratio.

Features

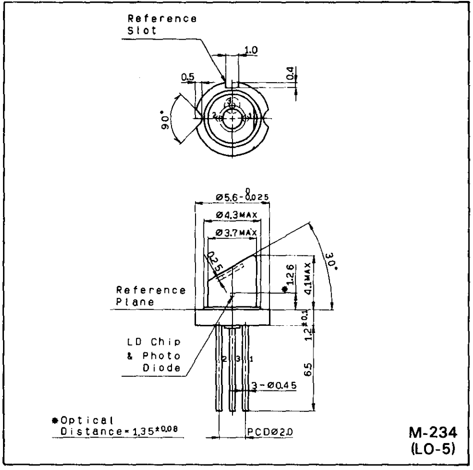
- Microminiaturized package (ϕ5.6 mm)
- Low noise
- Lateral single mode oscillation
- Cap calibrating astigmatism
- Uses single power supply

Structure

With built in visible laser diode of GaAlAs double hetero-type and a PIN Photodiode to monitor the laser beam output

Package Outline

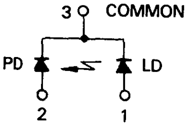
Unit: mm



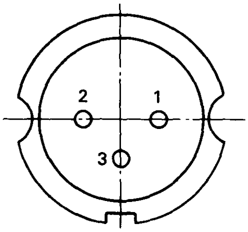
Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	Po	5	mW
• Reverse voltage	VR LD	2	V
	PIN Di	15	V
• Operating temperature	Topr	−10 to +70	°C
• Storage temperature	Tstg	−40 to +85	°C

Connection Diagram



Pin Configuration (Bottom View)



1. LD Anode
2. PIN Di Anode
3. COMMON

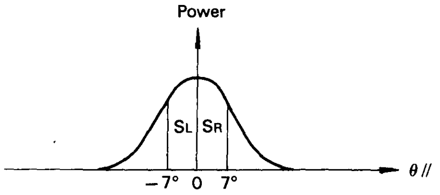
Electrical and Optical Characteristics (Tc = 25°C)

Tc : Case temperature

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith		30	60	80	mA
Operating current		Iop	Po = 3 mW	35	70	100	mA
Operating voltage		Vop	Po = 3 mW	1.7	1.9	2.5	V
Wavelength		λ	Po = 3 mW	760	780	800	nm
Monitor current		Im	Po = 3 mW VR = 5V	0.08	0.15	0.4	mA
F.W.H.M**	Perpendiculdar	$\theta \perp$	Po = 3 mW	25	35	45	degree
	Parallel	$\theta //$		9	18	25	degree
	Asymmetry	ΔSR*				20	%
Positional accuracy	Position	ΔX, ΔY, ΔZ	Po = 3 mW			±80	μm
	Angle	$\Delta\phi \perp$				±3	degree
Slope efficiency		η_D	Po = 3 mW	0.2	0.3	0.5	mW/mA
Astigmatism		As	Po = 3mW $\lvert Z // - Z \perp \rvert$			15	μm
Signal to noise ratio		S/N	fc = 7.5 MHz Δf = 30 kHz Po = 4 mW		88		dB
Dark current		ID	VR = 5V			150	nA
Capacitance of PD pin		Ct	VR = 5V, f = 1 MHz		14	30	pF

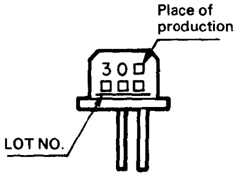
** Full Width at Half Maximum

*Note)

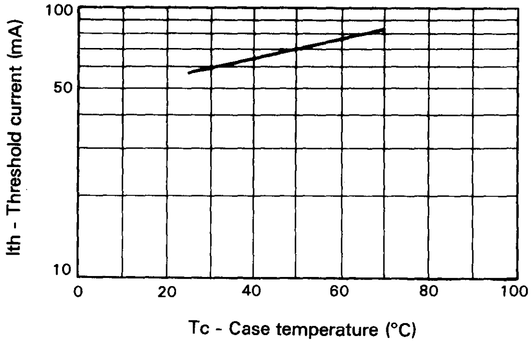


$$\Delta S_R = \frac{|S_L - S_R|}{S_L + S_R}$$

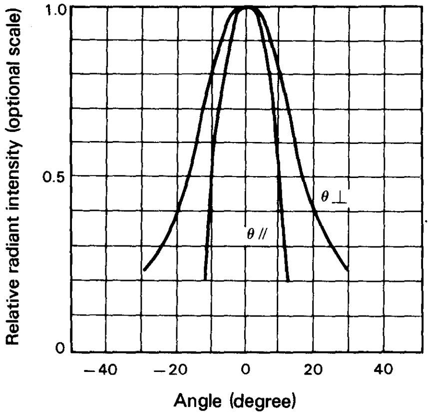
Mark



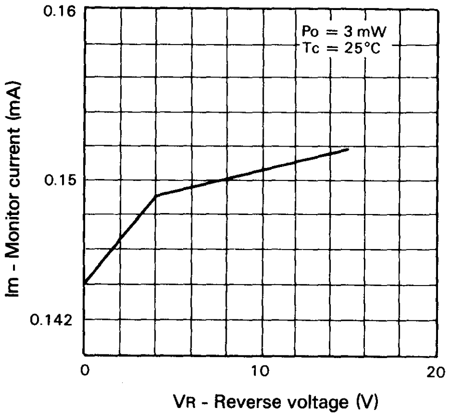
Threshold current vs. Temperature



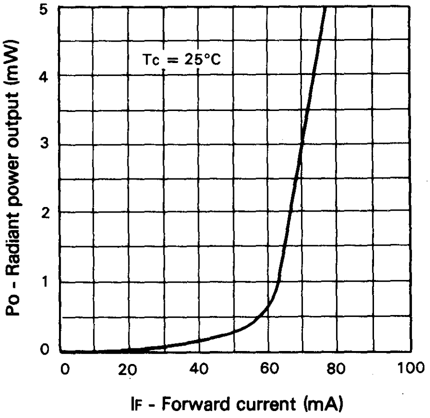
Far field pattern (FFP)



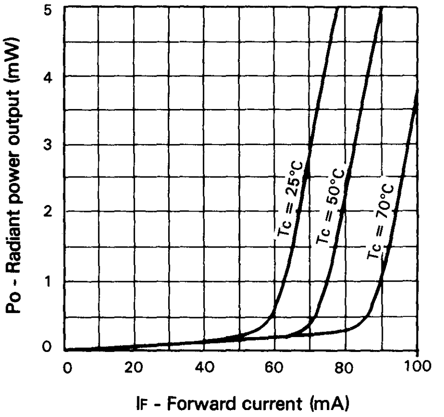
Monitor current vs. Reverse voltage



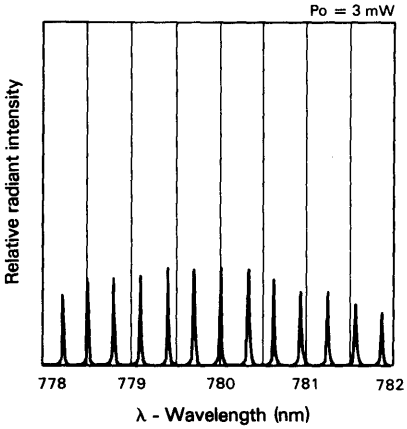
Radiant power output vs. Forward current



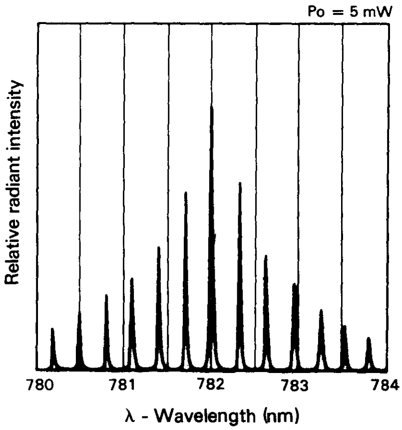
Radiant power output vs. Forward current temperature characteristics



Relative radiant intensity vs. Wavelength



Relative radiant intensity vs. Wavelength



SONY

SLD201U/V

20 mW High Power Laser Diode

Description

The SLD201U/V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- Low noise S/N=80 dB (Typ.) at 5 mW.

Structure

GaAlAs double-hetero laser diode.
PIN photo diode included for monitoring the laser radiant power output.

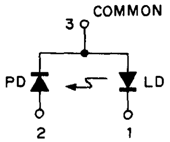
Application

Optical disc, Laser printer.

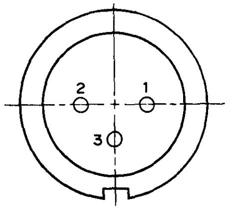
Absolute Maximum Ratings (Tc=25°C)

• Radiant power output	Po		20	mW
• Reverse voltage	VR	LD	2	V
		PIN Di	30	V
• Operating temperature	Topr		−10 to +50	°C
• Storage temperature	Tstg		−40 to +85	°C

Connection Diagram



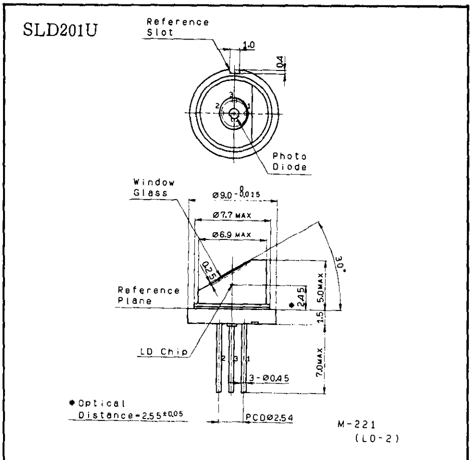
Pin Configuration (Bottom View)

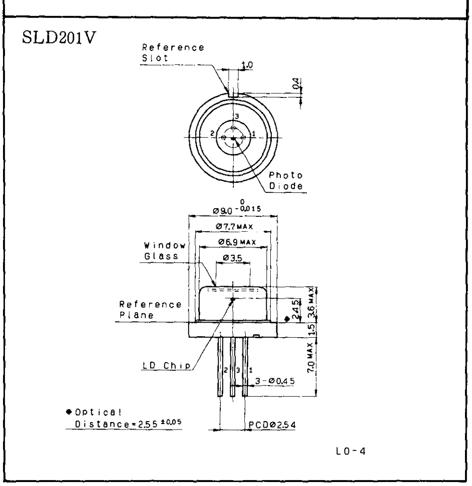


1. LD Cathode
2. PIN Di Anode
3. COMMON

Package Outline

Unit: mm





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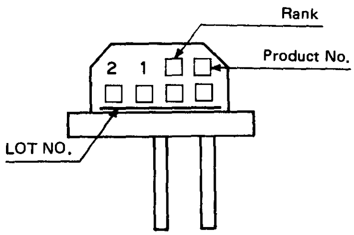


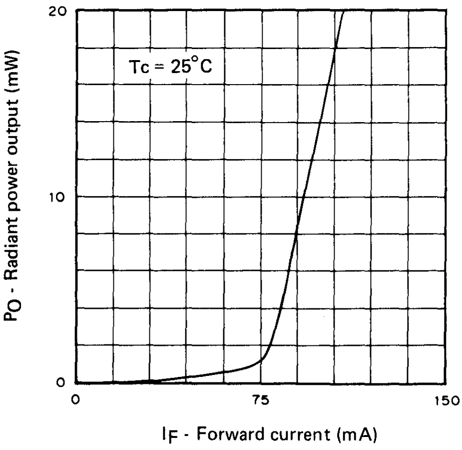
Electrical and Optical Characteristics

T_c=25°C

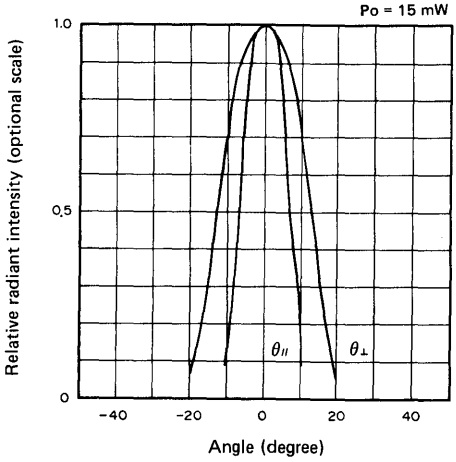
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}			65	95	mA
Operating current		I_{op1}	P_O=15mW		95	120	mA
Operating current		I_{op2}	P_O=15mW, T_c=50°C		120	150	mA
Operating voltage		V_{op}	P_O=15mW		1.9	2.5	V
Wavelength		λ		760	780	800	nm
Monitor current		I_m	P_O=15mW V_R=15V	0.05	0.30	1.2	mA
F.W.H.M.*	Perpendicular	$\theta_\perp$	P_O=15mW		28	38	degree
	Parallel	$\theta_{//}$		7	13	19	
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	P_O=15mW			±50	μm
	Angle	$\Delta\phi_\perp$				±3	degree
		$\Delta\phi_{//}$					
Slope efficiency		η_D	P_O=15mW	0.3	0.7		mW/mA
Astigmatism	SLD201U	As	$\lvert Z_{//}-Z_\perp \rvert$				μm
	SLD201V				40	60	
Dark current of Pin Di		I_D	V_R=15V			0.1	μA
Signal to noise ratio		S/N	f_c=720kHz Δf=30kHz P_O=5mW	60	80		dB

* Full Width at Half Maximum

Radiant power output vs. Forward current characteristics

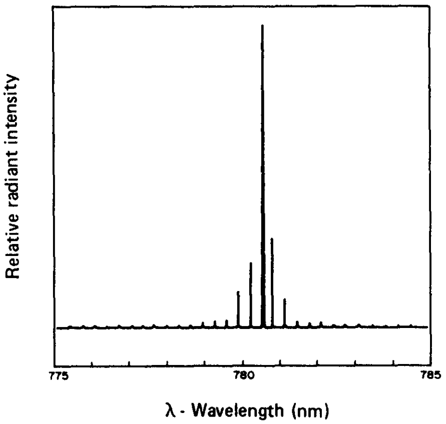


Far field pattern (FFP)



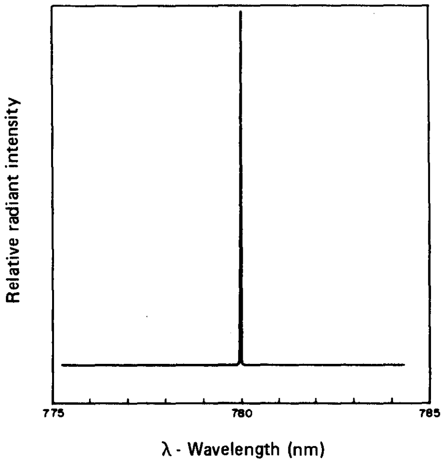
Relative radiant intensity vs. Wavelength characteristics.

Po = 5 mW



Relative radiant intensity vs. Wavelength characteristics

Po = 15 mW



SONY **SLD202U/V**

High Power Laser Diode

Description

The SLD202U/V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- Low noise S/N=80 dB (Typ.) at 5 mW.

Structure

GaAlAs double-hetero visible laser diode.
PIN photo diode included for monitoring the laser radiant power output.

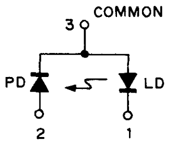
Application

Optical disc, Laser printer.

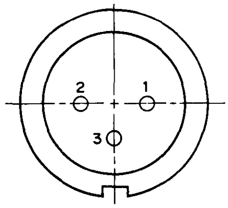
Absolute Maximum Ratings (Tc=25°C)

• Radiant power output	Po	25	mW
• Reverse voltage	V_R LD	2	V
	PIN Di	30	V
• Operating temperature	Topr	−10 to +50	°C
• Storage temperature	Tstg	−40 to +85	°C

Connection Diagram



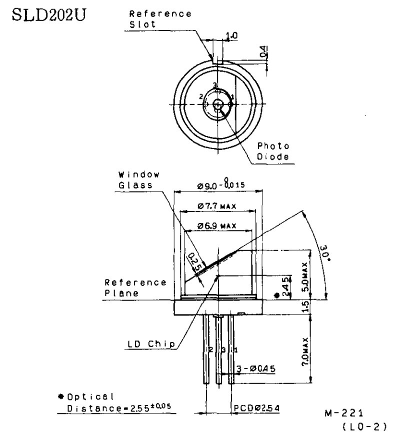
Pin Configuration (Bottom View)

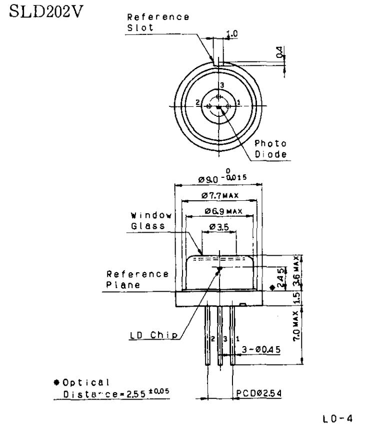


1. LD	Cathode	
2. PIN Di	Anode	
3. COMMON		

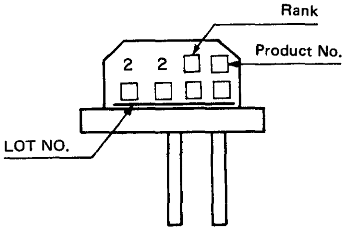
Package Outline

Unit: mm





Mark



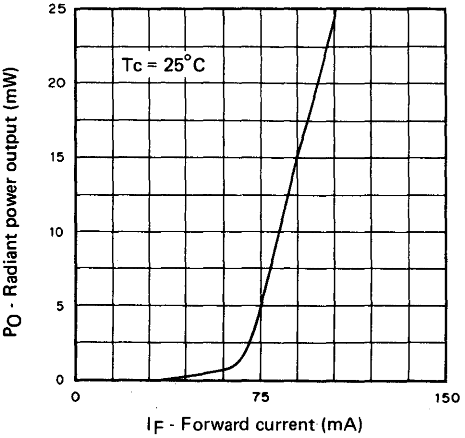
Electrical and Optical Characteristics

Tc=25°C

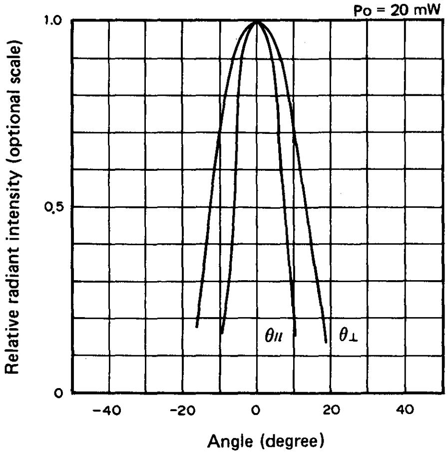
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			75	95	mA
Operating current		I_{op1}	Po=20mW		105	125	mA
Operating current		I_{op2}	Po=20mW, Tc=50°C		125	155	mA
Operating voltage		Vop	Po=20mW		1.9	2.5	V
Wavelength		λ		800	820	840	nm
Monitor current		Im	Po=20mW V_R=15V	0.07	0.40	1.6	mA
F.W.H.M.*	Perpendicular	$\theta_\perp$	Po=20mW		28	38	degree
	Parallel	$\theta_{//}$		7	13	19	
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	Po=20mW			±50	μm
	Angle	$\Delta\phi_\perp$ $\Delta\phi_{//}$				±3	degree
Slope efficiency		η_D	Po=20mW	0.3	0.7		mW/mA
Astigmatism	SLD202U	As	$\lvert Z_{//}-Z_\perp \rvert$				μm
	SLD202V				40	60	
Dark current of Pin Di		I_D	V_R=15V			0.1	μA
Signal to noise ratio		S/N	fc=720kHz Δf=30kHz Po=5mW	60	80		dB

* Full Width at Half Maximum

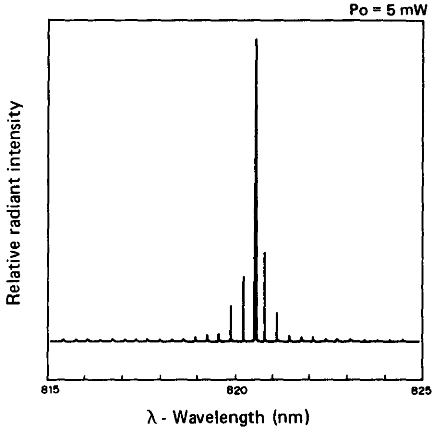
Radiant power output vs. Forward current characteristics



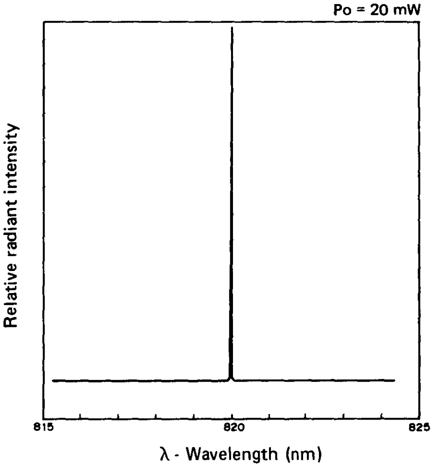
Far field pattern (FFP)



Relative radiant intensity vs. Wavelength characteristics



Relative radiant intensity vs. Wavelength characteristics



SONY

SLD201U/V-3

50 mW High Power Laser Diode

Description

The SLD201U/V-3 is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- Low noise S/N=80 dB (Typ.) at 5 mW.

Structure

GaAIAs double-hetero visible laser diode.
PIN photo diode included for monitoring the laser radiant power output.

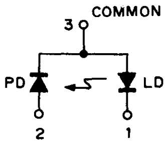
Application

Optical disc, Laser printer.

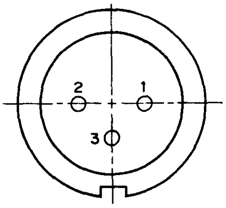
Absolute Maximum Ratings (Tc=25°C)

• Radiant power output	Po		50	mW
• Reverse voltage	VR	LD	2	V
		PIN Di	30	V
• Operating temperature	Topr		−10 to +50	°C
• Storage temperature	Tstg		−40 to +85	°C

Connection Diagram



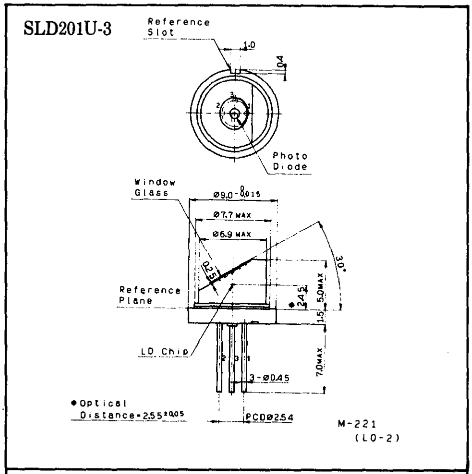
Pin Configuration (Bottom View)

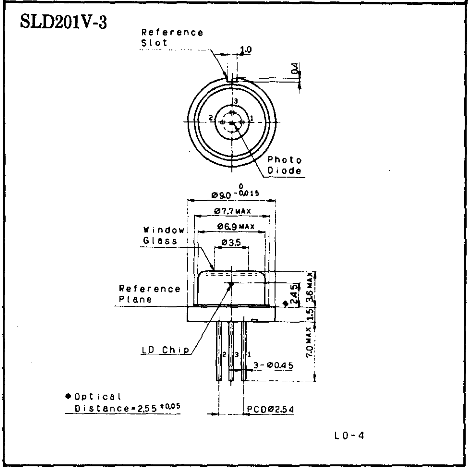


1.	LD	Cathode
2.	PIN Di	Anode
3.	COMMON	

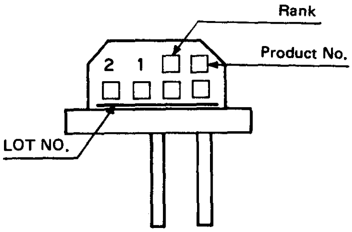
Package Outline

Unit: mm





Mark



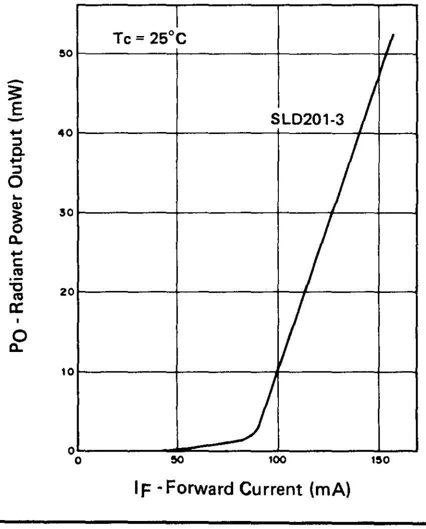
Electrical and Optical Characteristics

Tc=25°C

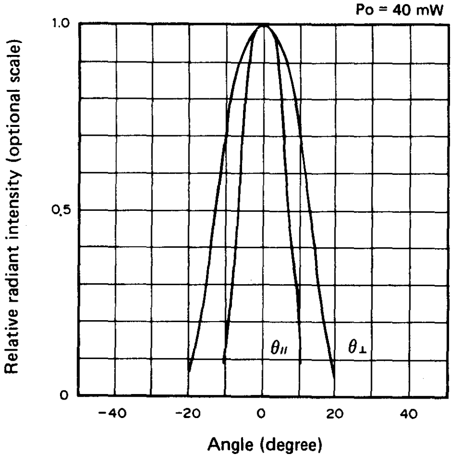
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			90		mA
Operating current		Iop1	Po=40mW		140		mA
Operating current		Iop2	Po=40mW, Tc=50°C		165		mA
Operating voltage		Vop	Po=40mW		2.3		V
Wavelength		λ		760	780	800	nm
Monitor current		Im	Po=40mW VR=15V		0.30		mA
F.W.H.M.*	Perpendicular	$\theta_{\perp}$	Po=40mW		28	38	degree
	Parallel	$\theta_{/\!/}$		7	13	19	
Positional accuracy	Position	ΔX,ΔY,ΔZ	Po=40mW			±50	μm
	Angle	$\Delta\phi_{\perp}$ $\Delta\phi_{/\!/}$				±3	degree
Slope efficiency		η_D	Po=40mW		0.8		mW/mA
Astigmatism	SLD201U	As	$\lvert Z_{/\!/}-Z_{\perp}\rvert$				μm
	SLD201V				40	60	
Dark current of Pin Di		ID	VR=15V			0.1	μA
Signal to noise ratio		S/N	fc=720kHz Δf=30kHz Po=5mW	60	80		dB

* Full Width at Half Maximum

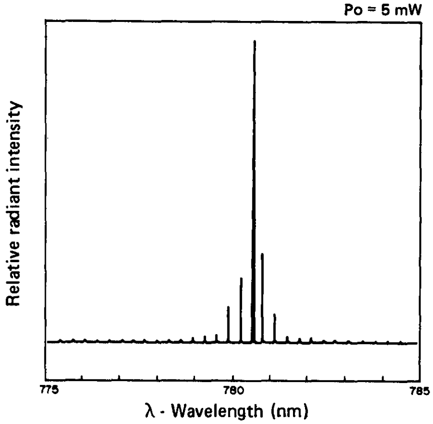
Radiant power output vs. Forward current characteristics



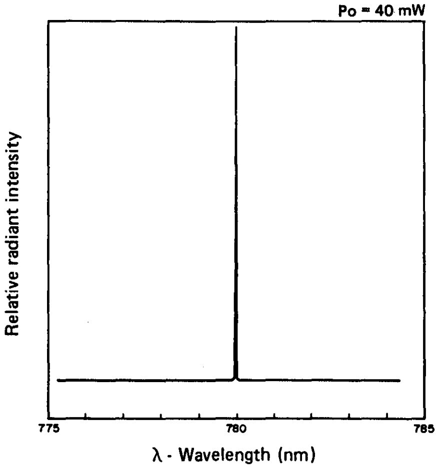
Far field pattern (FFP)



Relative radiant intensity vs. Wavelength characteristics



Relative radiant intensity vs. Wavelength characteristics



SONY SLD202U/V-3

50 mW High Power Laser Diode

Description

The SLD202U/V-3 is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- Low noise S/N=80 dB (Typ.) at 5 mW.

Structure

GaAlAs double-hetero laser diode.
PIN photo diode included for monitoring the laser radiant power output.

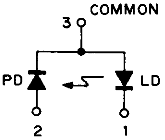
Application

Optical disc, Laser printer, Nd: YAG excitation.

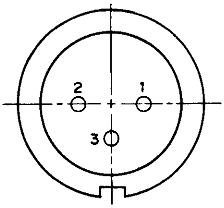
Absolute Maximum Ratings (Tc=25°C)

• Radiant power output	Po	50	mW
• Reverse voltage	VR LD	2	V
	PIN Di	30	V
• Operating temperature	Topr	−10 to +50	°C
• Storage temperature	Tstg	−40 to +85	°C

Connection Diagram



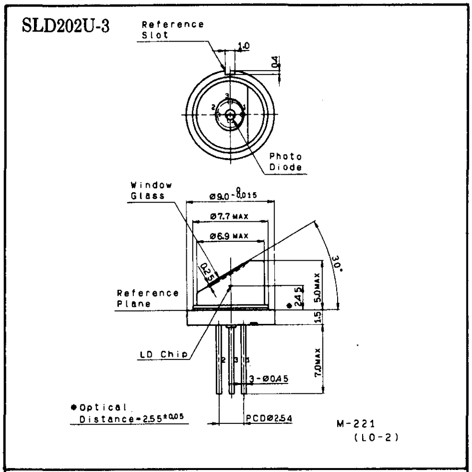
Pin Configuration (Bottom View)

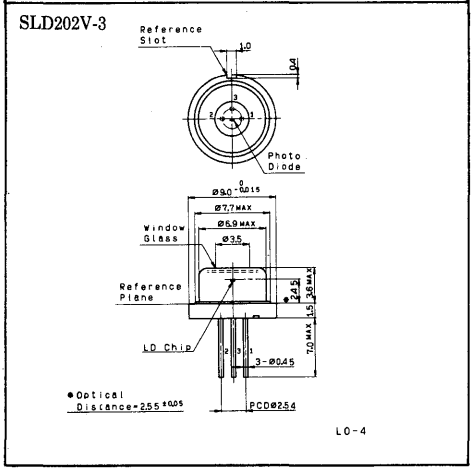


1. LD	Cathode
2. PIN Di	Anode
3. COMMON	

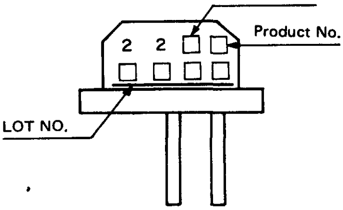
Package Outline

Unit: mm





Mark



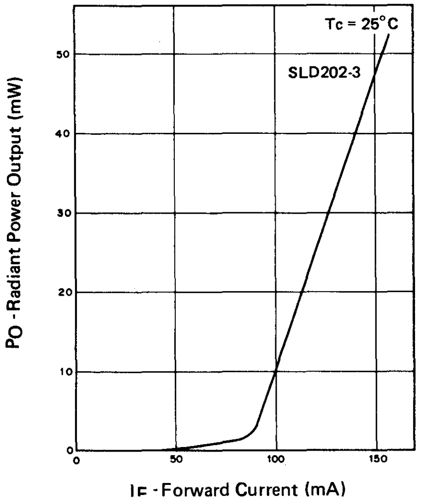
Electrical and Optical Characteristics

Tc=25°C

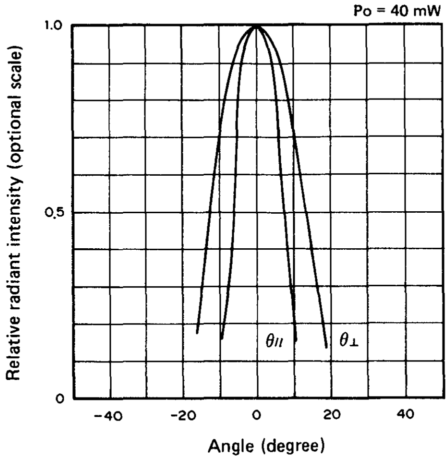
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			90		mA
Operating current		I_{op1}	Po=40mW		140		mA
Operating current		I_{op2}	Po=40mW, Tc=50°C		165		mA
Operating voltage		Vop	Po=40mW		2.3		V
Wavelength		λ		800	820	840	nm
Monitor current		Im	Po=40mW V_R=15V		0.30		mA
F.W.H.M.*	Perpen-dicular	$\theta_\perp$	Po=40mW		28	38	degree
	Parallel	$\theta_{//}$		7	13	19	
Positional accuracy	Position	ΔX,ΔY,ΔZ	Po=40mW			±50	μm
	Angle	$\Delta\phi_\perp$ $\Delta\phi_{//}$				±3	degree
Slope efficiency		η_D	Po=40mW		0.8		mW/mA
Astigmatism	SLD202U	As	$\lvert Z_{//}-Z_\perp \rvert$				μm
	SLD202V				40	60	
Dark current of Pin Di		I_D	V_R=15V			0.1	μA
Signal to noise ratio		S/N	fc=720kHz Δf=30kHz Po=5mW	60	80		dB

* Full Width at Half Maximum

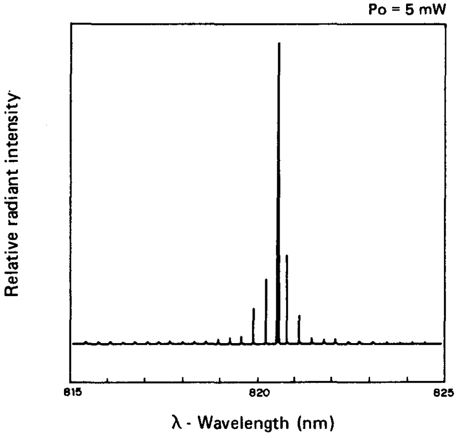
Radiant power output vs. Forward current characteristics



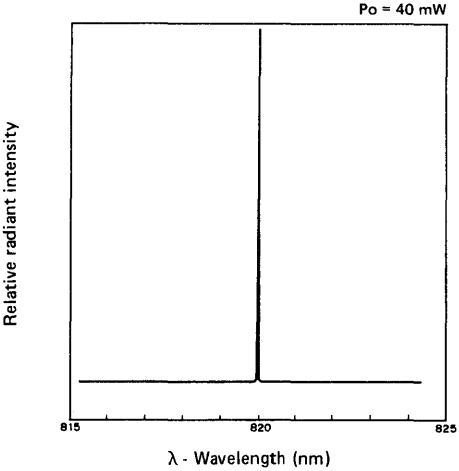
Far field pattern (FFP)



Relative radiant intensity vs. Wavelength characteristics



Relative radiant intensity vs. Wavelength characteristics



SONY **SLD203V**

High Power Laser Diode

Description

The SLD203V is an index-guided high-power laser diode fabricated by MOCVD.

Structure

GaAlAs double-hetero visible laser diode.
PIN photo diode incorporated for monitoring the laser radiant power output.

Application

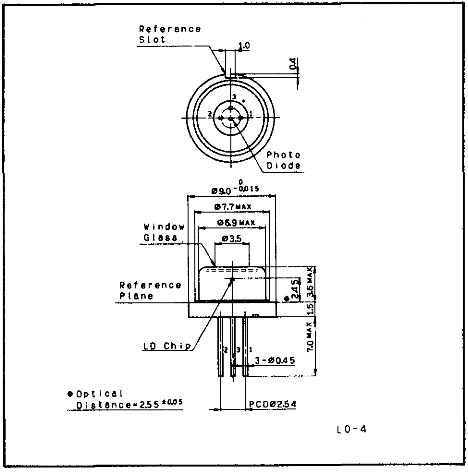
Optical disc, Laser printer.

Absolute Maximum Ratings (Tc=25°C)

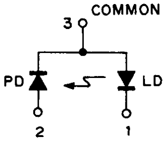
• Radiant power output	Po	30	mW
• Reverse voltage	VR LD	2	V
	PIN Di	30	V
• Operating temperature	Topr	−10 to +50	°C
• Storage temperature	Tstg	−40 to +85	°C

Package Outline

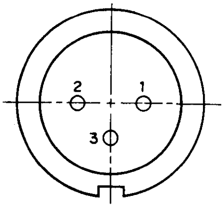
Unit: mm



Connection Diagram

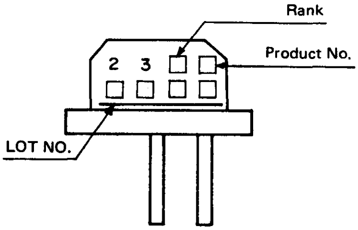


Pin Configuration (Bottom View)



1. LD	Cathode
2. PIN Di	Anode
3. COMMON	

Mark



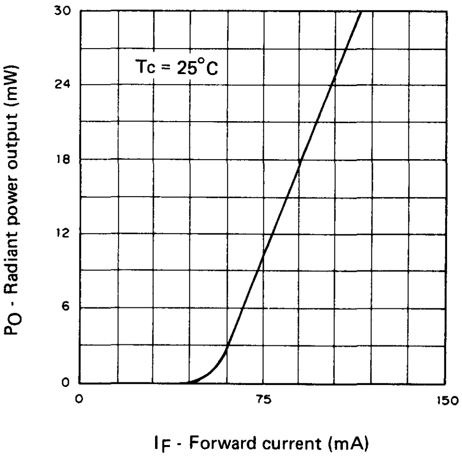
Electrical and Optical Characteristics

(T_C=25°C)

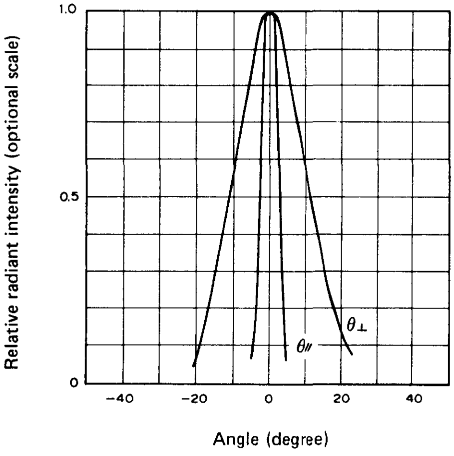
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}			50	75	mA
Operating current		I_{op1}	P_O=25mW		100	125	mA
Operating current		I_{op2}	P_O=25mW, T_C=50°C		120	155	mA
Operating voltage		V_{op}	P_O=25mW		1.9	2.5	V
Wavelength		λ	P_O=25mW	760	780	800	nm
Monitor current		I_m	P_O=25mW V_R=15V	0.07	0.50	2.0	mA
F.W.H.M.*	Perpendicular	$\theta_\perp$	P_O=25mW		26	35	degree
	Parallel	$\theta_{/\!/}$		4	10	18	
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	P_O=25mW			±50	μm
	Angle	$\Delta\phi_\perp$				±3	degree
		$\Delta\phi_{/\!/}$				±2	
Slope efficiency		η_D	P_O=25mW	0.3	0.5		mW/mA
Astigmatism		As	$\lvert Z_{/\!/} - Z_\perp \rvert$		5	10	μm
Dark current of Pin Di		I_D	V_R=15V			0.1	μA

* Full Width at Half Maximum

Radiant power output vs. Forward current characteristics



Far field pattern (FFP)



SONY

SLD204V

High Power Laser Diode

Description

The SLD204V is an index-guided high-power laser diode fabricated by MOCVD.

Structure

GaAlAs double-hetero laser diode.
PIN photo diode incorporated for monitoring the laser radiant power output.

Application

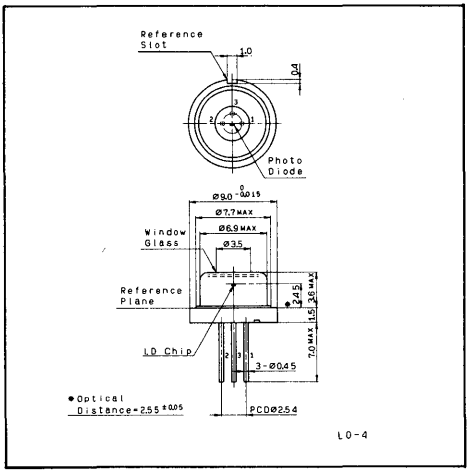
Optical disc, Laser printer.

Absolute Maximum Ratings (Tc=25°C)

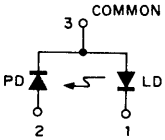
• Radiant power output	Po		40	mW
• Reverse voltage	V_R	LD	2	V
		PIN Di	30	V
• Operating temperature	Topr		−10 to +50	°C
• Storage temperature	Tstg		−40 to +85	°C

Package Outline

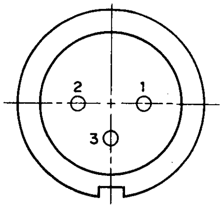
Unit: mm



Connection Diagram

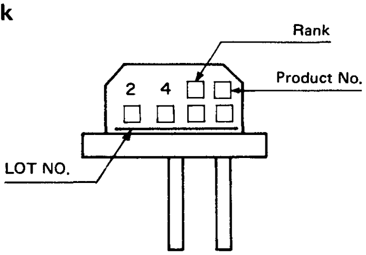


Pin Configuration (Bottom View)



1. LD Cathode
2. PIN Di Anode
3. COMMON

Mark



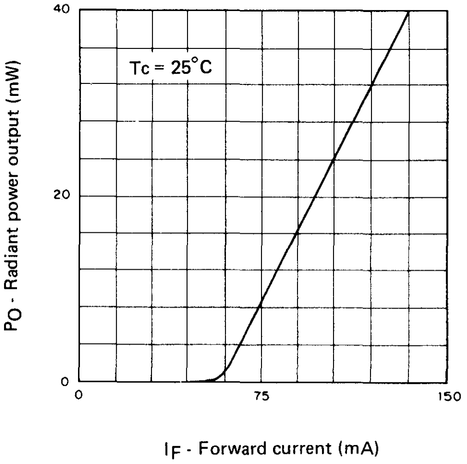
Electrical and Optical Characteristics

(Tc=25°C)

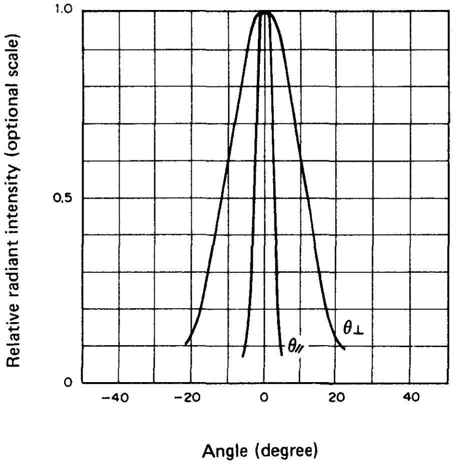
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}		20	50	75	mA
Operating current		I_{op1}	P_O=30mW	80	110	135	mA
Operating current		I_{op2}	P_O=30mW, T_C=50°C		135	165	mA
Operating voltage		V_{op}	P_O=30mW		1.9	2.5	V
Wavelength		λ	P_O=30mW	800	820	840	nm
Monitor current		I_m	P_O=30mW V_R=15V	0.10	0.60	2.0	mA
F.W.H.M.*	Perpendicular	$\theta_{\perp}$	P_O=30mW		26	35	degree
	Parallel	$\theta_{//}$		4	7	18	
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	P_O=30mW			±50	µm
	Angle	$\Delta\phi_{\perp}$				±3	degree
		$\Delta\phi_{//}$				±2	
Slope efficiency		η_D	P_O=30mW	0.3	0.5		mW/mA
Astigmatism		As	$\lvert Z_{//}-Z_{\perp}\rvert$		5	10	µm
Dark current of Pin Di		I_D	V_R=15V			0.1	µA

* Full Width at Half Maximum

Radiant power output vs. Forward current characteristics



Far field pattern (FFP)



SONY SLD 301V

100 mW High Power Laser Diode **Preliminary**

Description

The SLD 301V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_O = 100$ mW
- Small Operating Current

Structure

GaAlAs double-hetero laser diode.

Application

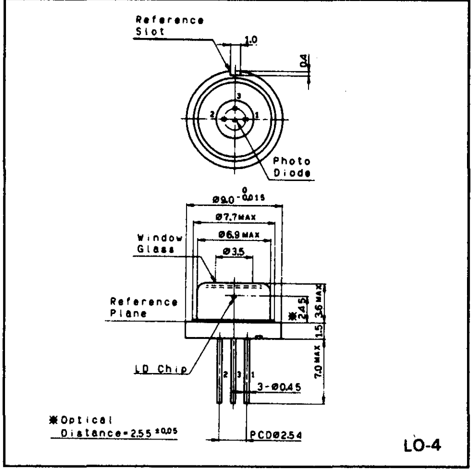
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings ($T_c = 25$°C)

- Radiant power output P_O 100 mW
- Reverse voltage V_R LD 2 V
  PIN Di 15 V
- Operating temperature T_{opr} −10 to +50 °C
- Storage temperature T_{stg} −40 to +85 °C

Package Outline

Unit: mm



Electrical and Optical Characteristics

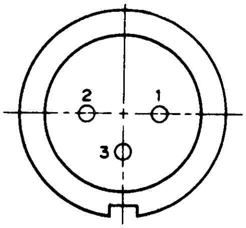
$T_c = 25$°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}			200		mA
Operating current		I_{OP}	$P_O = 90$ mW		300		mA
Operating voltage		V_{OP}	$P_O = 90$ mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_\perp$	$P_O = 90$ mW		28		degree
	Parallel	$\theta_{/\!/}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	$P_O = 90$ mW			±50	μm
	Angle	$\Delta\phi_{/\!/}$					degree
		$\Delta\phi_\perp$				±3	degree
Slope efficiency		η_D	$P_O = 90$ mW		0.8		mW/mA

*Wavelength Selection

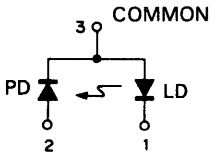
Model	Wavelength
SLD301V-1	785 ± 15 nm
SLD301V-2	810 ± 10 nm
SLD301V-3	830 ± 10 nm

Pin Configuration

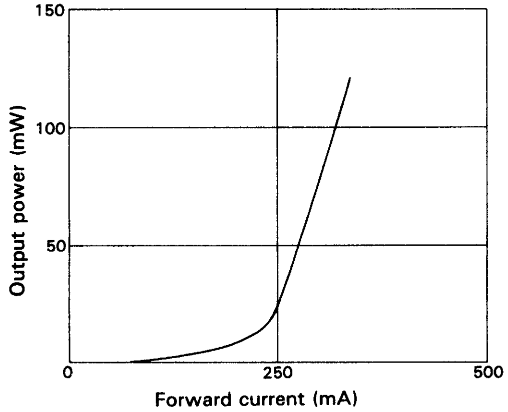


Bottom View
1. LD Cathode
2. PD Anode
3. COMMON

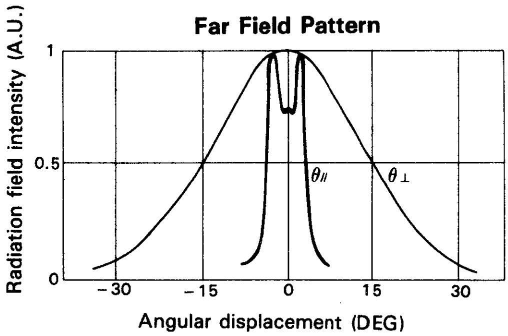
Connection Diagram



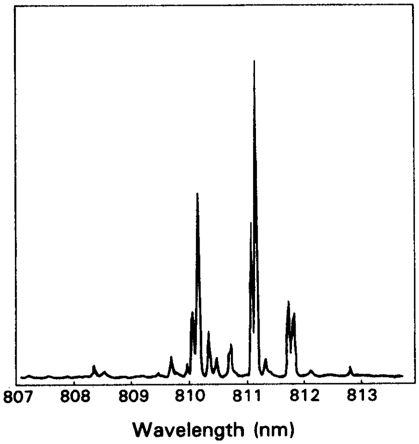
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY® **SLD 301W**

100 mW High Power Laser Diode

Preliminary

Description

The SLD 301W is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 100$ mW
- Small Operating Current

Structure

GaAIAs double-hetero laser diode.

Application

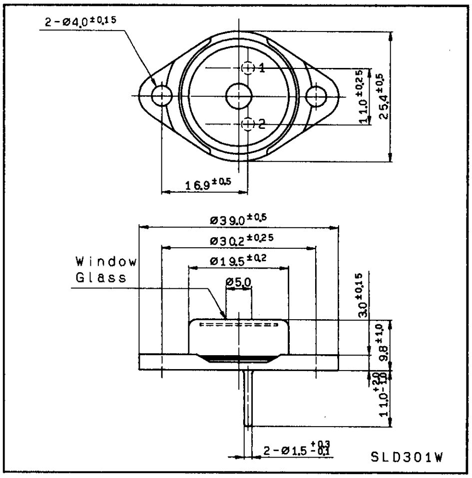
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	P_o	100	mW
• Reverse voltage	V_R	LD 2	V
• Operating temperature	T_{opr}	−10 to +50	°C
• Storage temperature	T_{stg}	−40 to +85	°C

Package Outline

Unit: mm



Electrical and Optical Characteristics

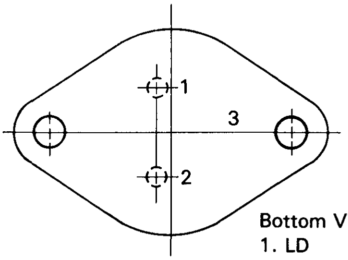
Tc = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			200		mA
Operating current		I_{OP}	$P_o = 90$ mW		300		mA
Operating voltage		V_{OP}	$P_o = 90$ mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_{\perp}$	$P_o = 90$ mW		28		degree
	Parallel	$\theta_{/\!/}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	$P_o = 90$ mW			±50	μm
	Angle	$\Delta\phi_{/\!/}$					degree
		$\Delta\phi_{\perp}$				±3	degree
Slope efficiency		η_D	$P_o = 90$ mW		0.8		mW/mA

*Wavelength Selection

Model	Wavelength
SLD301W-1	785 ± 15 nm
SLD301W-2	810 ± 10 nm
SLD301W-3	830 ± 10 nm

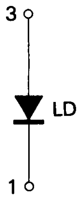
Pin Configuration



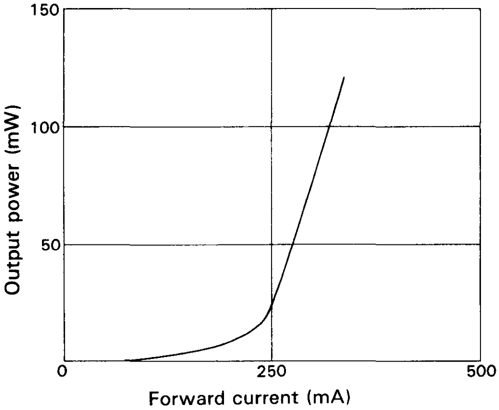
Bottom View

1. LD	Cathode
2. Not connected	
3. LD	Anode (case)

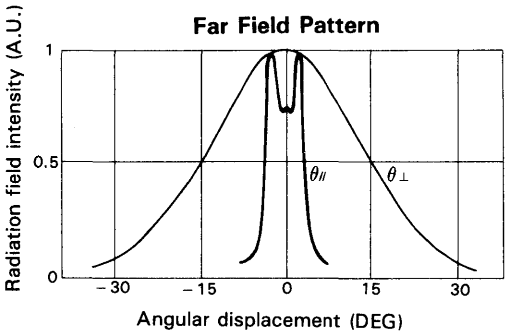
Connection Diagram



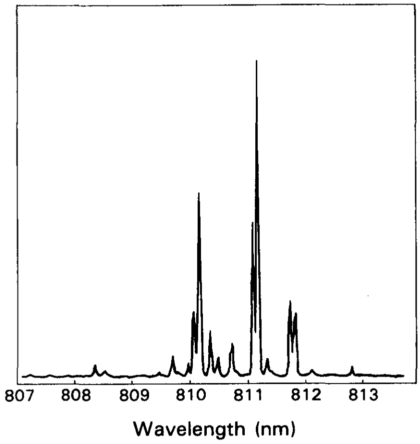
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY SLD 302V

200 mW High Power Laser Diode **Preliminary**

Description

The SLD 302V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power P_o = 200 mW
- Small Operating Current

Structure

GaAlAs double-hetero laser diode.

Application

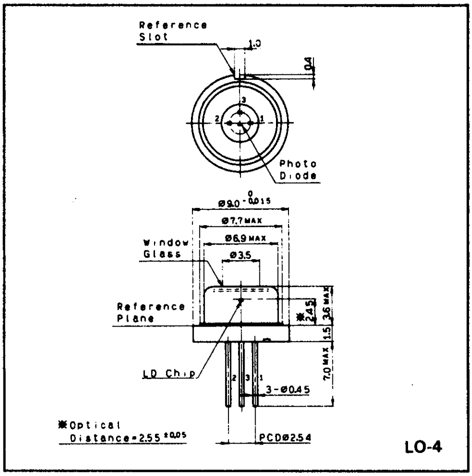
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	P_o		200	mW
• Reverse voltage	V_R	LD	2	V
		PIN Di	15	V
• Operating temperature	T_{opr}	−10	to +50	°C
• Storage temperature	T_{stg}	−40	to +85	°C

Package Outline

Unit: mm



Electrical and Optical Characteristics

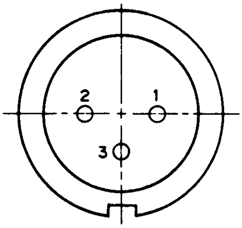
Tc = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			200		mA
Operating current		I_{OP}	Po = 180 mW		400		mA
Operating voltage		V_{OP}	Po = 180 mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_{\perp}$	Po = 180 mW		28		degree
	Parallel	$\theta_{//}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	Po = 180 mW			±50	μm
	Angle	$\Delta\phi_{//}$					degree
		$\Delta\phi_{\perp}$				±3	degree
Slope efficiency		η_D	Po = 180 mW		0.8		mW/mA

*Wavelength Selection

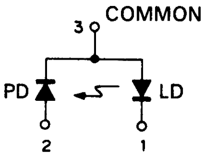
Model	Wavelength
SLD302V-1	785 ± 15 nm
SLD302V-2	810 ± 10 nm
SLD302V-3	830 ± 10 nm

Pin Configuration

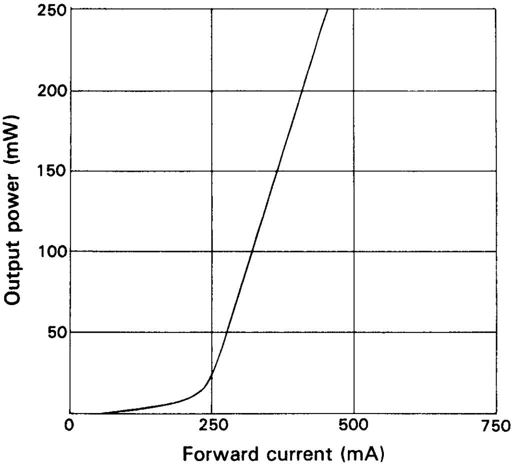


Bottom View
1. LD Cathode
2. PD Anode
3. COMMON

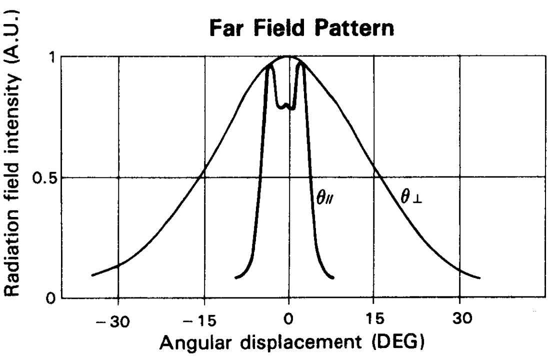
Connection Diagram



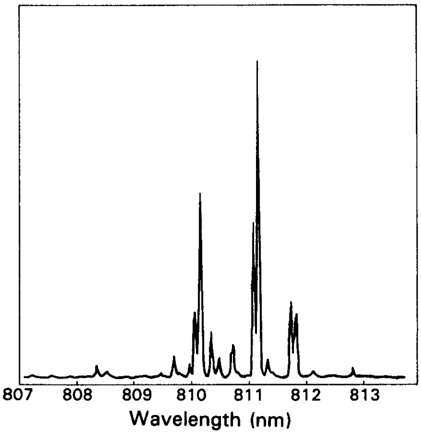
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY **SLD 302W**

200 mW High Power Laser Diode

Preliminary

Description

The SLD 302W is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 200$ mW
- Small Operating Current

Structure

GaAlAs double-hetero laser diode.

Application

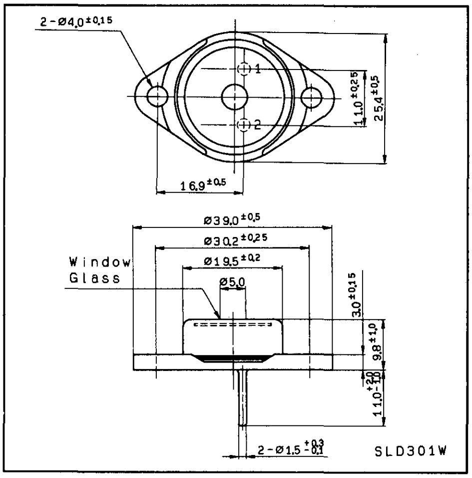
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings ($T_c = 25°C$)

- Radiant power output P_o 200 mW
- Reverse voltage V_R LD 2 V
- Operating temperature T_{opr} −10 to +50 °C
- Storage temperature T_{stg} −40 to +85 °C

Package Outline

Unit: mm



Electrical and Optical Characteristics

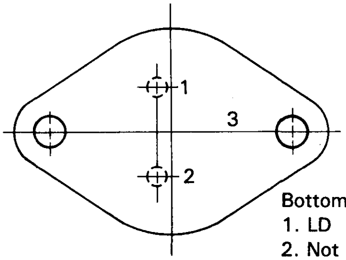
$T_c = 25°C$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}			200		mA
Operating current		I_{OP}	$P_o = 180$ mW		400		mA
Operating voltage		V_{OP}	$P_o = 180$ mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_{\perp}$	$P_o = 180$ mW		28		degree
	Parallel	$\theta_{//}$			9		degree
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	$P_o = 180$ mW			±50	µm
	Angle	$\Delta\phi_{//}$					degree
		$\Delta\phi_{\perp}$				±3	degree
Slope efficiency		η_D	$P_o = 180$ mW		0.8		mW/mA

*Wavelength Selection

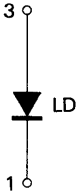
Model	Wavelength
SLD302W-1	785 ± 15 nm
SLD302W-2	810 ± 10 nm
SLD302W-3	830 ± 10 nm

Pin Configuration

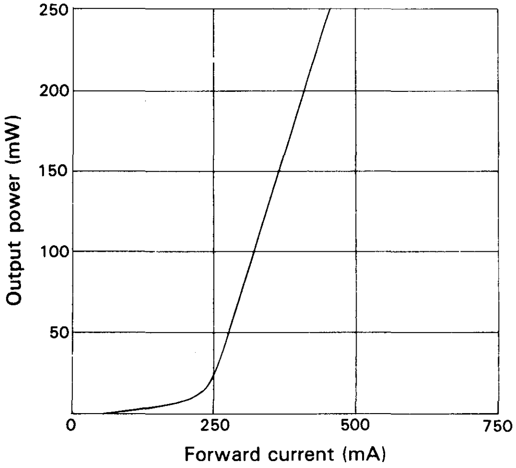


Bottom View
1. LD Cathode
2. Not connected
3. LD Anode (case)

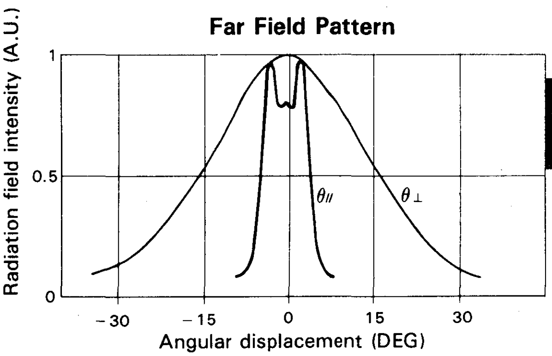
Connection Diagram



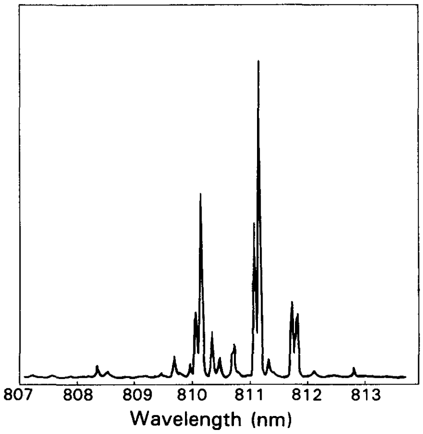
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY

SLD 303V

500 mW High Power Laser Diode

Preliminary

Description

The SLD 303V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 500$ mW
- Small Operating Current

Structure

GaAlAs double-hetero laser diode.

Application

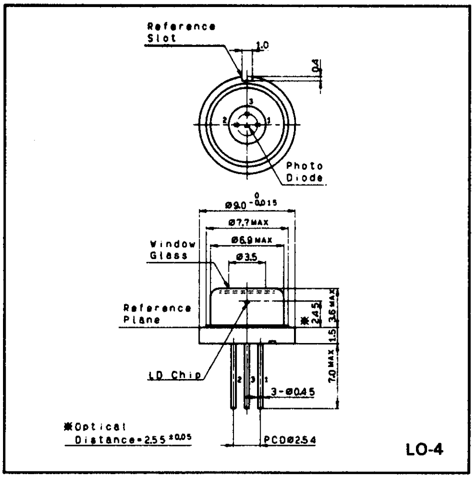
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	P_o		500			mW
• Reverse voltage	V_R	LD	2			V
		PIN Di	15			V
• Operating temperature	T_{opr}		−10	to	+30	°C
• Storage temperature	T_{stg}		−40	to	+85	°C

Package Outline

Unit: mm



Electrical and Optical Characteristics

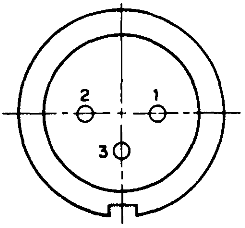
Tc = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			400		mA
Operating current		I_{OP}	Po = 450 mW		1000		mA
Operating voltage		V_{OP}	Po = 450 mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_\perp$	Po = 450 mW		28		degree
	Parallel	$\theta_{/\!/}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	Po = 450 mW			±50	μm
	Angle	$\Delta\phi_{/\!/}$					degree
		$\Delta\phi_\perp$				±3	degree
Slope efficiency		η_D	Po = 450 mW		0.8		mW/mA

*Wavelength Selection

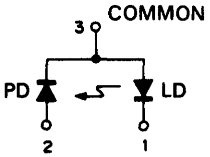
Model	Wavelength
SLD303V-1	785 ± 15 nm
SLD303V-2	810 ± 10 nm
SLD303V-3	830 ± 10 nm

Pin Configuration

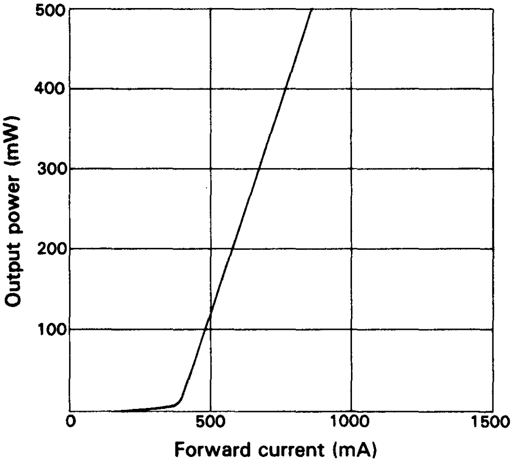


Bottom View
1. LD Cathode
2. PD Anode
3. COMMON

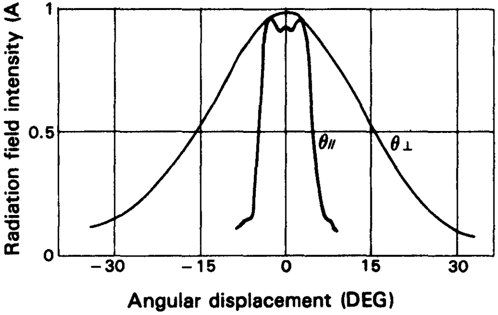
Connection Diagram



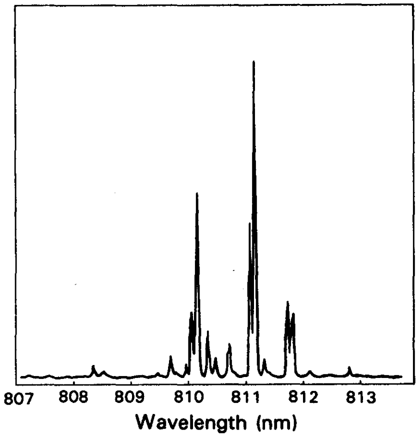
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY®

SLD 303W

500 mW High Power Laser Diode

Preliminary

Description

The SLD 303W is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 500$ mW
- Small Operating Current

Structure

GaAlAs double-hetero laser diode.

Application

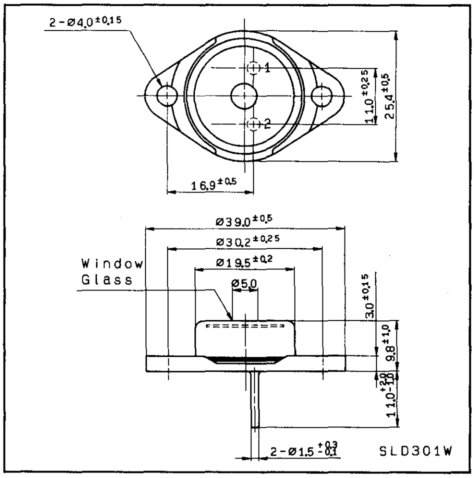
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	P_o	500	mW
• Reverse voltage	V_R	LD 2	V
• Operating temperature	T_{opr}	−10 to +30	°C
• Storage temperature	T_{stg}	−40 to +85	°C

Package Outline

Unit: mm



Electrical and Optical Characteristics

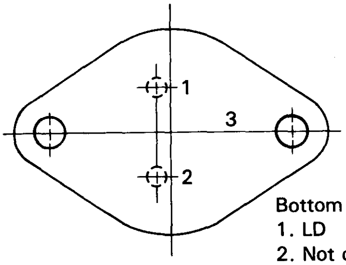
Tc = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			400		mA
Operating current		I_{OP}	Po = 450 mW		1000		mA
Operating voltage		V_{OP}	Po = 450 mW		1.9		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_{\perp}$	Po = 450 mW		28		degree
	Parallel	$\theta_{//}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	Po = 450 mW			±50	µm
	Angle	$\Delta\phi_{//}$					degree
		$\Delta\phi_{\perp}$				±3	degree
Slope efficiency		η_D	Po = 450 mW		0.8		mW/mA

*Wavelength Selection

Model	Wavelength
SLD303W-1	785 ± 15 nm
SLD303W-2	810 ± 10 nm
SLD303W-3	830 ± 10 nm

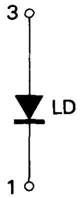
Pin Configuration



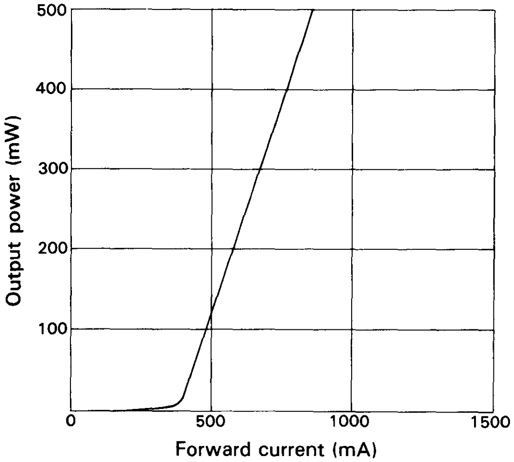
Bottom View

1.	LD	Cathode
2.	Not connected	
3.	LD	Anode (case)

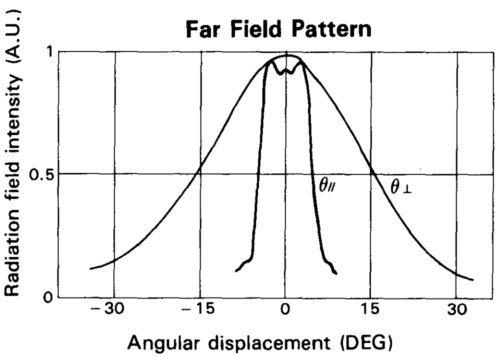
Connection Diagram



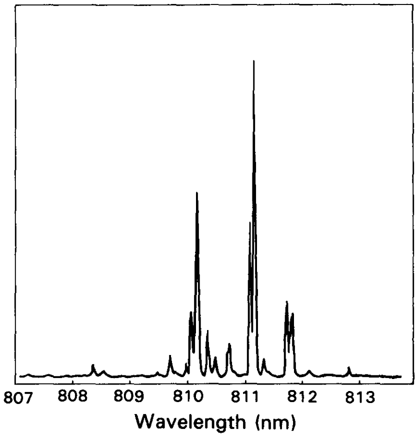
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY

SLD 304V

1000 mW High Power Laser Diode

Preliminary

Description

The SLD 304V is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 1000$ mW
- Small Operating Current

Structure

GaAIAs double-hetero laser diode.

Application

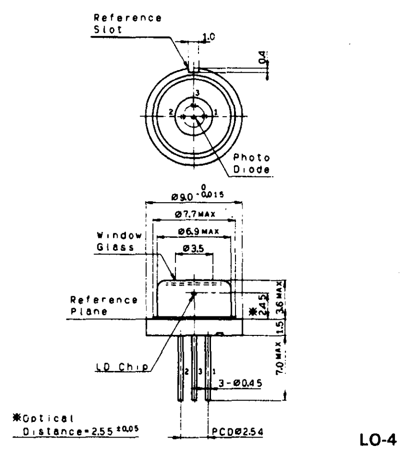
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings ($Tc = 25°C$)

- Radiant power output P_o 1000 mW
- Reverse voltage V_R LD 2 V
  PIN Di 15 V
- Operating temperature T_{opr} −10 to +30 °C
- Storage temperature T_{stg} −40 to +85 °C

Package Outline

Unit: mm



Electrical and Optical Characteristics

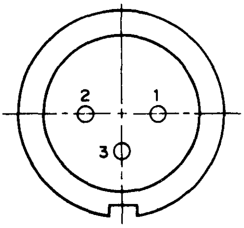
$Tc = 25°C$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		I_{th}			400		mA
Operating current		I_{OP}	$P_o = 900$ mW		1500		mA
Operating voltage		V_{OP}	$P_o = 900$ mW		2.1		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_\perp$	$P_o = 900$ mW		28		degree
	Parallel	$\theta_{//}$			9		degree
Positional accuracy	Position	$\Delta X, \Delta Y, \Delta Z$	$P_o = 900$ mW			±50	μm
	Angle	$\Delta\phi_{//}$					degree
		$\Delta\phi_\perp$				±3	degree
Slope efficiency		η_D	$P_o = 900$ mW		0.8		mW/mA

*Wavelength Selection

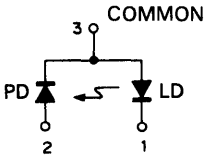
Model	Wavelength
SLD304V-1	785 ± 15 nm
SLD304V-2	810 ± 10 nm
SLD304V-3	830 ± 10 nm

Pin Configuration

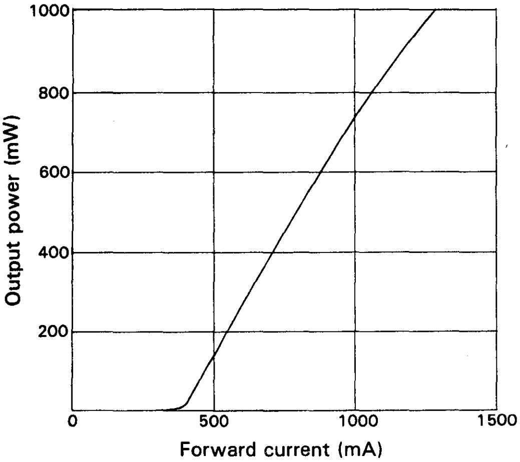


Bottom View
1. LD Cathode
2. PD Anode
3. COMMON

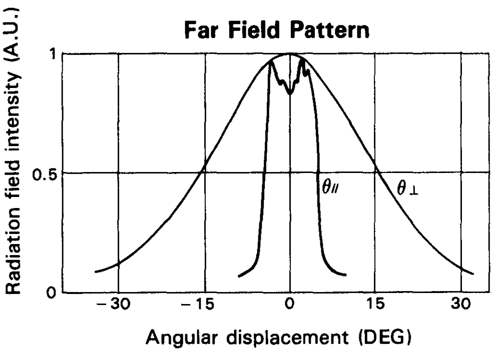
Connection Diagram



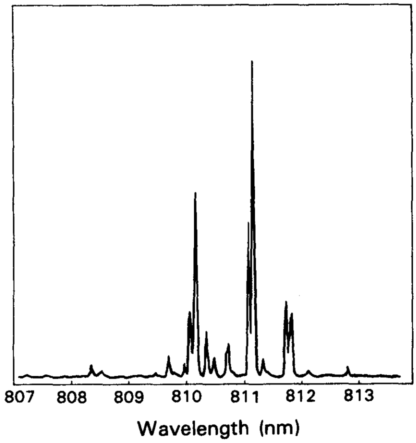
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



SONY SLD 304W

1000 mW High Power Laser Diode

Preliminary

Description

The SLD 304W is a gain-guided high-power laser diode fabricated by MOCVD.

Features

- High Power $P_o = 1000$ mW
- Small Operating Current

Structure

GaAIAs double-hetero laser diode.

Application

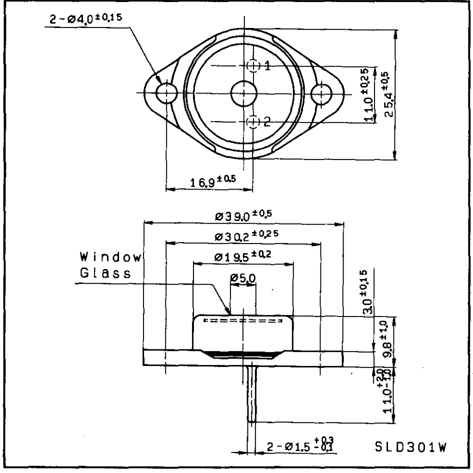
- Medical and Communications.
- Nd : YAG laser Excitation

Absolute Maximum Ratings (Tc = 25°C)

• Radiant power output	P_o	1000	mW
• Reverse voltage	V_R	LD 2	V
• Operating temperature	T_{opr}	−10 to +30	°C
• Storage temperature	T_{stg}	−40 to +85	°C

Package Outline

Unit: mm



Electrical and Optical Characteristics

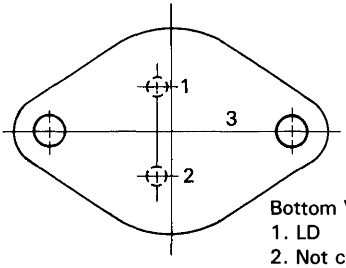
Tc = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Threshold current		Ith			400		mA
Operating current		I_{OP}	Po = 900 mW		1500		mA
Operating voltage		V_{OP}	Po = 900 mW		2.1		V
Wavelength*		λ		770		840	nm
F.W.H.M	Perpendicular	$\theta_\perp$	Po = 900 mW		28		degree
	Parallel	$\theta_{//}$			9		degree
Positional accuracy	Position	ΔX, ΔY, ΔZ	Po = 900 mW			±50	μm
	Angle	$\Delta\phi_{//}$					degree
		$\Delta\phi_\perp$				±3	degree
Slope efficiency		η_D	Po = 900 mW		0.8		mW/mA

*Wavelength Selection

Model	Wavelength
SLD304W-1	785 ± 15 nm
SLD304W-2	810 ± 10 nm
SLD304W-3	830 ± 10 nm

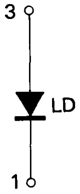
Pin Configuration



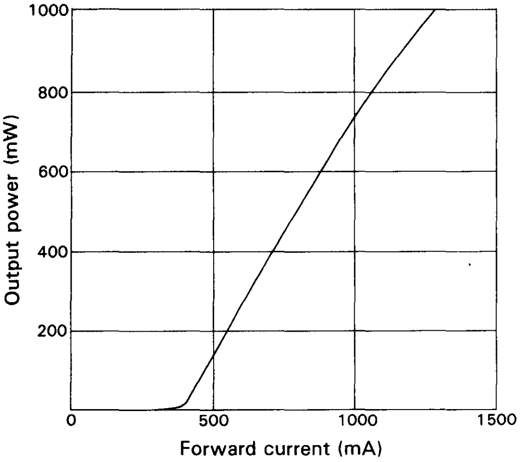
Bottom View

1. LD	Cathode
2. Not connected	
3. LD	Anode (case)

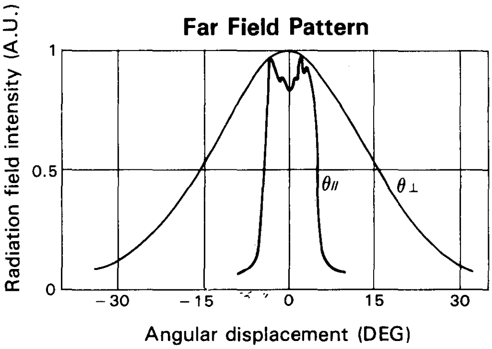
Connection Diagram



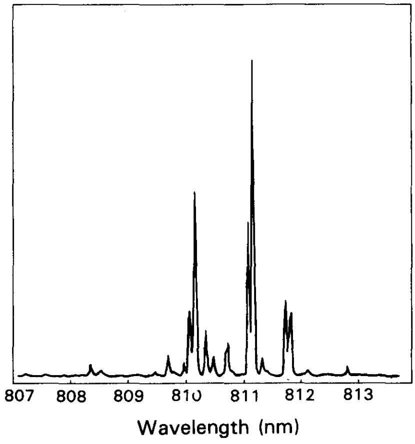
Light Output vs. Current Curve



Far Field Pattern



Longitudinal Mode



Field Effect Transistors

3) Field Effect Transistors

(A) Silicon N-Channel junction FET

Type	Application	Feature	Page
2SK121	Low frequency, Low noise amplifier, high frequency amplifier	General purpose FET TO-92	114
2SK125	UHF amplifier	Wide dynamic range I_{DDS}=40 to 75mA TO-92	119
2SK152	Preamplifier for camera and video	Forward transfer admittance $\mid Y_{fs} \mid$=30ms TO-92	128
2SK300	Preamplifier for camera and video	Forward transfer admittance $\mid Y_{fs} \mid$=30ms 3 pin minimold	135

3) Field Effect Transistors

(B) AlGaAs/GaAs N-Channel HEMT (High Electron Mobilty Transistor)

Type	Application	Feature	Page
2SK676	Low noise microwave amplifier	High gain low noise, NF Max.=1.4dB (f=12GHz) Ceramic package	142
2SK677	Low noise microwave amplifier	High gain low noise, NF Max.=1.4dB (f=12GHz) Ceramic package	146
2SK676H5	Low noise microwave amplifier	High gain low noise, NF Max.=1.4dB (f=12GHz) Chip	150
2SK677H5	Low noise microwave amplifier	High gain low noise, NF Max.=1.4dB (f=12GHz) Chip	157
2SK877	Low noise microwave amplifier	Low Noise Low Cost Ceramic package	164
2SK878	Low noise microwave amplifier	Low Noise Low Cost Ceramic package	168

3) Field Effect Transistors

(C) GaAs N-Channel Dual Gate MES FET

Type	Application	Feature	Page
3SK164/-M	UHF amplifier, mixer, oscillator	Incorporates gate protection diode, High power gain PG Max=22dB, Low noise NF (Typ.)=1.2dB(F=800MHz) 4 Pin minimold	173
3SK165	UHF amplifier, mixer, oscillator	Low input capacitance Ciss=0.5pF, High power gain PG Max=20dB, Low noise NF (Typ.)=1.2dB(F=800MHz) 4 Pin minimold	177
3SK166	UHF amplifier, oscillator	High forward transfer admittance $\mid Y_{fs} \mid$=40ms, Low noise (NF)=1.2dB(F=800MHz) 4 Pin minimold	181

SONY **2SK121**

Silicon N-Channel Junction FET

Description

The 2SK121 is a junction type FET which has the feature of obtaining high voltage high gm and low noise which covers from the Audio band to the VHF band.

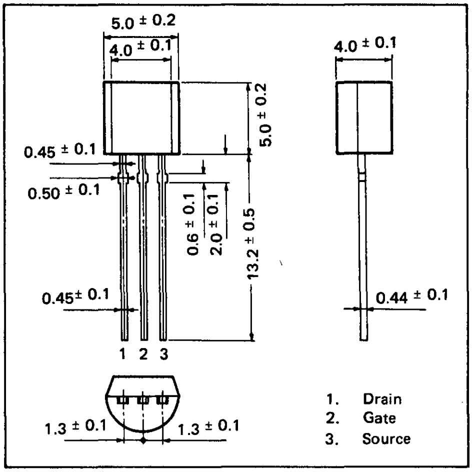
Application

For low frequency, low noise amplifier and high-frequency amplifier.

Structure

N-channel Silicon junction FET

Package Outline Unit: mm



Absolute Maximum Ratings (Ta=25°C)

• Drain-to-Gate Voltage	V_{DGO}	30	V
• Source-to-Gate Voltage	V_{SGO}	30	V
• Drain current	I_D	20	mA
• Gate current	I_G	5	mA
• Allowable power dissipation	P_D	300	mW
• Junction temperature	Tj	100	°C
• Storage temperature	Tstg	−50 to +120	°C

Electrical Characteristics

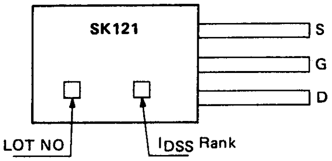
($T_a=25°C$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Gate to Source Voltage	V_{GSS}	$I_G=10\mu A$, $V_{DS}=0V$	−30			V
Gate Cutoff Current	I_{GSS}	$V_{GS}=-15V$, $V_{DS}=0V$			−1.0	nA
Drain Current	I_{DSS}	$V_{DS}=10V$, $V_{GS}=0V$	0.9		14.3	mA
Gate to Source Cutoff Voltage	$V_{GS(OFF)}$	$V_{DS}=10V$, $I_D=30\mu A$	−0.18		−1.49	V
Forward Transfer Admittance	$\|Y_{fs}\|$	$V_{DS}=10V$, $V_{GS}=0V$, f=1kHz	6.3			mS
Junction to Ambient Thermal Resistance	$\theta_{j\text{-}a}$				250	°C/W

(Standard subdivision)

Rank	I_{DSS} ($V_{DS}=10V$, $V_{GS}=0V$)
2	2.7 to 5.5 mA
3	4.5 to 7.7 mA
4	6.3 to 9.9 mA
5	8.1 to 12.1 mA

Mark

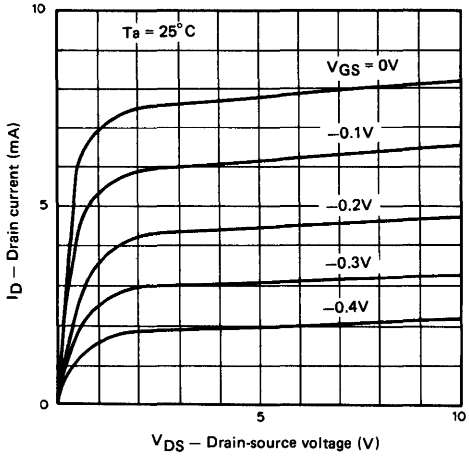


Circuit Design Reference Material

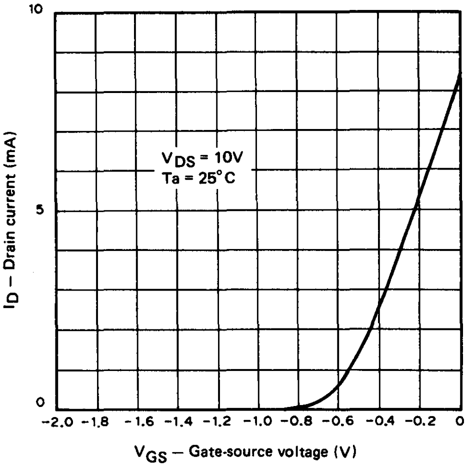
($T_a=25°C$)

Item	Symbol	Condition	Typ.	Unit
Input Admittance Y_{11s}	r_{ip}	f=100MHz $V_{DS}=10V$, $V_{GS}=0V$	1.2	kΩ
	C_{ip}		13	pF
Output Admittance Y_{22s}	r_{op}	f=100MHz $V_{DS}=10V$, $V_{GS}=0V$		kΩ
	C_{op}		2.7	pF
Reverse Transfer Capacitance	C_{rss}	f=1MHz, $V_{DS}=10V$, $V_{GS}=0V$	2.4	pF
Short Circuit Equivalent Input Noise Voltage	$\bar{e}_n$	$V_{GS}=0V$, f=1kHz $V_{DS}=10V$, Rg=10kΩ	13	nv/$\sqrt{Hz}$

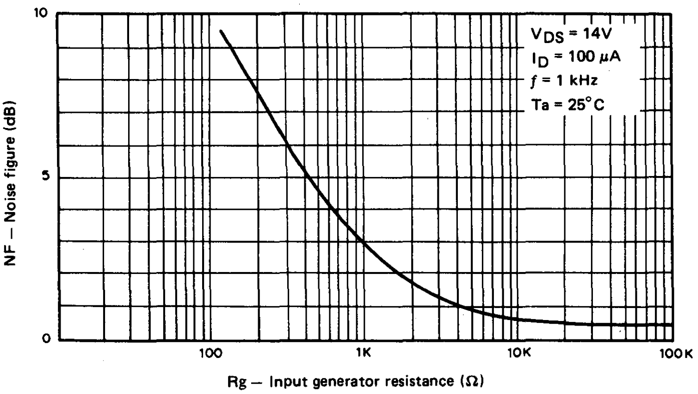
Drain Current vs. Drain-Source Voltage

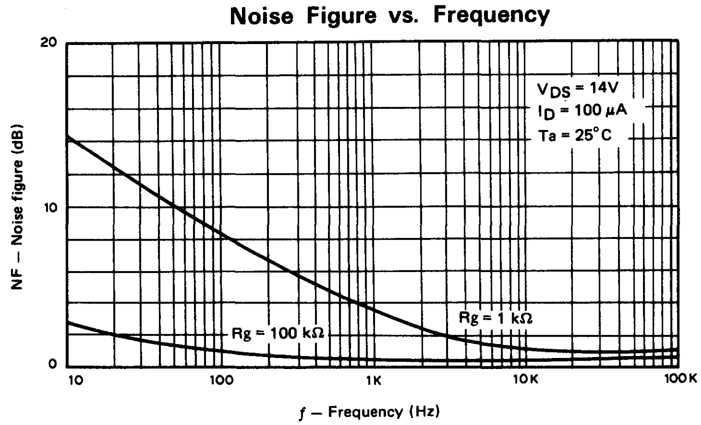


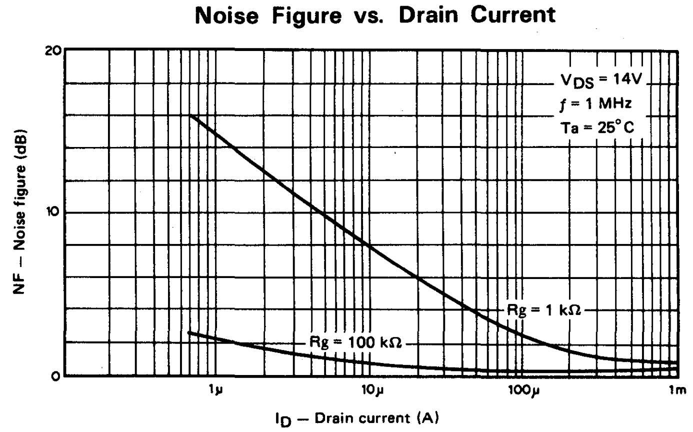
Drain Current vs. Gate-Source Voltage

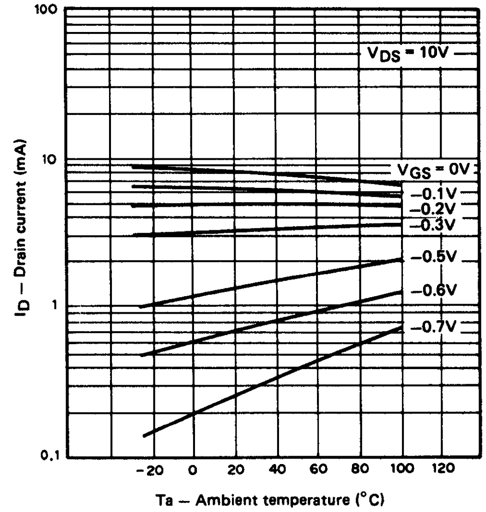


Noise Figure vs. Input Generator Resistance

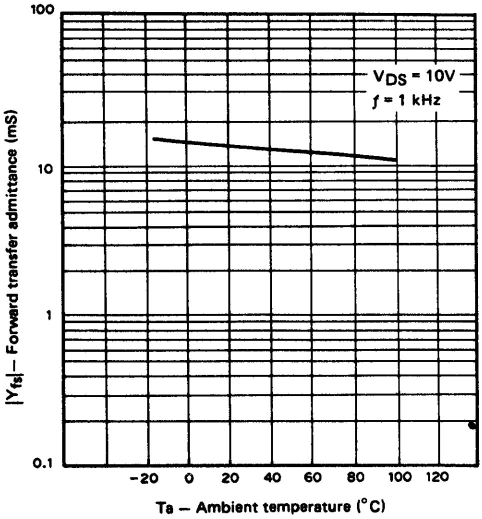



Noise Figure vs. Frequency
20
10
0
NF — Noise figure (dB)
10
100
1K
10K
100K
f — Frequency (Hz)
VDS = 14V
ID = 100 μA
Ta = 25°C
Rg = 1 kΩ
Rg = 100 kΩ

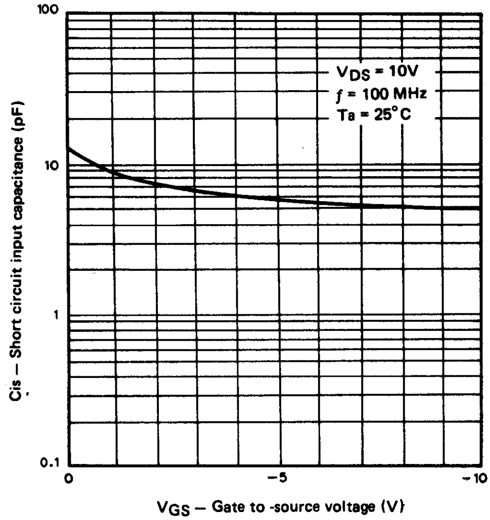

Noise Figure vs. Drain Current
20
10
0
NF — Noise figure (dB)
1μ
10μ
100μ
1m
ID — Drain current (A)
VDS = 14V
f = 1 MHz
Ta = 25°C
Rg = 1 kΩ
Rg = 100 kΩ



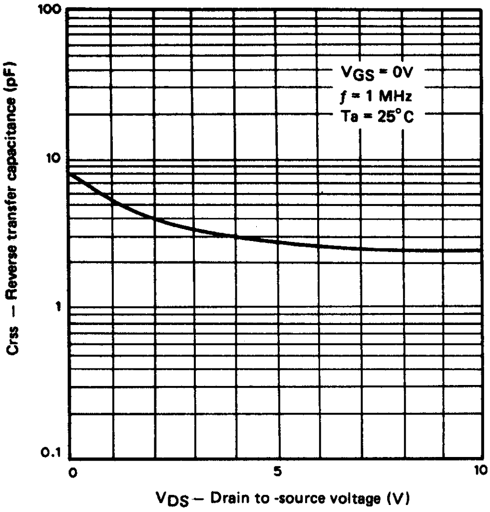
Drain Current vs. Temperature



Forward Transfer Admittance vs. Ambient Temperature



Short Circuit Input Capacitance vs. Gate-Source Voltage



Reverse Transfer Capacitance vs. Drain-Source Voltage

SONY

2SK125

Silicon N-Channel Junction FET

Description

The 2SK125 is an N-Channel silicon junction type field effect transistor developed for low-noise amplification at frequencies up to UHF. It is especially suitable for when a wide dynamic range is required.

Features

- High power gain
  12.5 dB (Typ.)
  (f=100 MHz Gate grounded)
- Low noise figure
  1.5 dB (Typ.)
  (f=100 MHz Gate grounded)
- Wide dynamic range
  3rd intermodulation distortion
  −52 dB (Typ.)
  (f=100 MHz at 100 dBμ input)
- Small inverse transfer coefficient
  $|S_{12}| = 0.035$ (Typ.)
  (f=500 MHz Gate grounded)

Structure

Silicon N-Channel junction FET.

Application

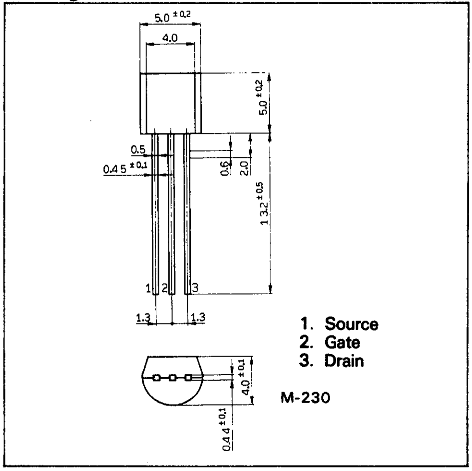
UHF band amplification, mixing, oscillation, analog switches.

Absolute Maximum Ratings (Ta = 25°C)

• Drain to gate voltage	V_{DGO}	35	V
• Source to gate voltage	V_{SGO}	35	V
• Drain current	I_D	100	mA
• Gate current	I_G	10	mA
• Channel temperature	Tj	120	°C
• Storage temperature	Tstg	−50 to +120	°C
• Allowable power dissipation	P_D	300	mW

Package Outline

Unit: mm



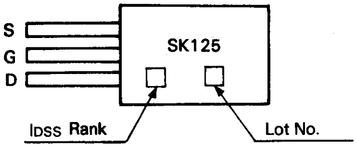
Electrical Characteristics

Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Gate cutoff current	I_{GSS}	V_{GS} = −15V, V_{DS} =0			−10	nA
Gate to source voltage	V_{GSS}	I_G = 10μA, V_{DS} =0	−35			V
Drain current	I_{DSS}	V_{DS} =10V, V_{GS} =0 P.W =300μs	40		75	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS} =10V, I_D =100μA	−2		−6	V
Forward transfer conductance	$\|Y_{fs}\|$	V_{DS} =10V, I_D =10mA f =1 kHz	10	14		mS
Reverse transfer capacitance	Crss	V_{DG} =10V, I_S =0mA f =1 MHz, source grounded		2.6	3	pF
Power gain	PG	V_{DG} =10V, I_D =10mA *1 f =100 MHz, BW =2.8 MHz	10	12.5		dB
Noise figure	NF	V_{DG} =10V, I_D =10mA *1 f =100 MHz, BW =2.8 MHz At the NF of the amplifier in the next stage is 4.2 dB		1.8	2.5	dB
Intermodulation distortion	IMD	V_{DG} =10V, I_D =10mA, *2 f1 =100 MHz, f2 =100.1 MHz, at 100 dBμ input	−45	−52		dB
Junction to ambient thermal resistance	θj-a				190	°C/W

Note) *1. See the 100 MHz, PG, NF, test circuit.
*2. See the 100 MHz IMD test circuit.

Mark



Classification

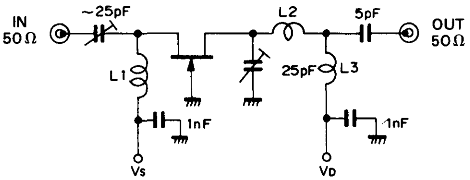
Rank	I_{DSS} (mA) V_{DS} = 10V V_{GS} = 0V
2	40 to 75
3	40 to 52
4	48 to 63
5	57 to 75

Standard Circuit Design Data

Ta = 25°C

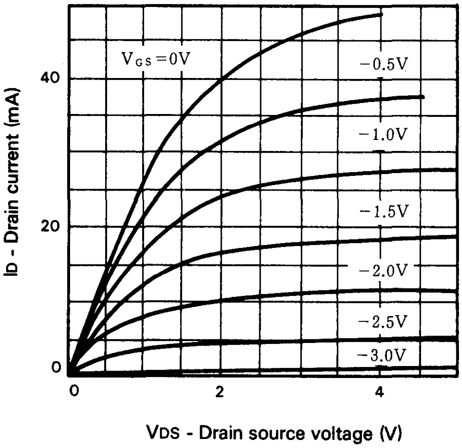
Item	Symbol	Condition	Typ.	Unit
Input resistance	r_{ig}	V_{DG} = 10V, I_D = 10 mA f = 100 MHz	70	Ω
Input capacitance	C_{ig}		3.0	pF
Output resistance	r_{og}		5	kΩ
Output capacitance	C_{og}		3.0	pF
Power gain	PG	V_{DG} = 10V, I_D = 10 mA f = 500 MHz, BW = 12 MHz	7.0	dB
Noise figure	NF		4.0	dB
Reverse transfer coefficient	$\|S_{12}\|$	V_{DG} = 10V, I_D = 10 mA f = 500 MHz	0.035	
Equivalent input noise voltage	$\overline{e}_n$	V_{DS} = 10V, I_D = 10 mA f = 1 kHz	3	$nV/\sqrt{Hz}$
Drain source ON resistance	$R_{(ON)}$	I_D = 10 mA, V_{GS} = 0V	35	Ω
Drain cutoff current	$I_{D(OFF)}$	V_{DS} = 10V, V_{GS} = −10V	0.1	nA

100 MHz PG, NF Test Circuit

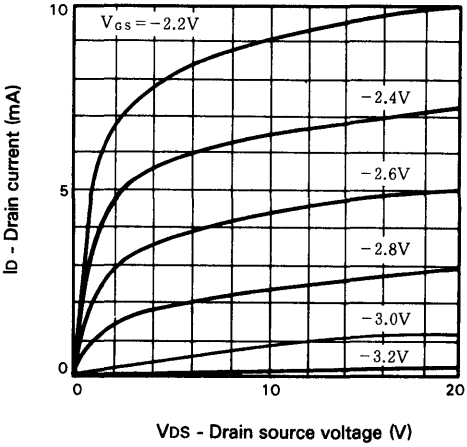


L1 : 0.45 ϕmm polyurethane wire ϕ3 mm 10.5 t
L2, L3 : 0.45 ϕmm polyurethane wire ϕ3 mm 5.5 t

Output Characteristics

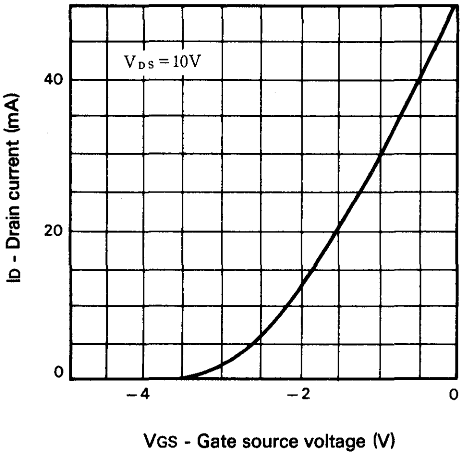


Drain current vs. Drain source voltage

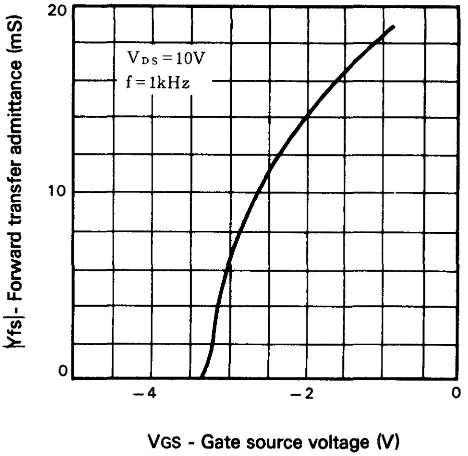


Drain current vs. Drain source voltage

Transfer Characteristics

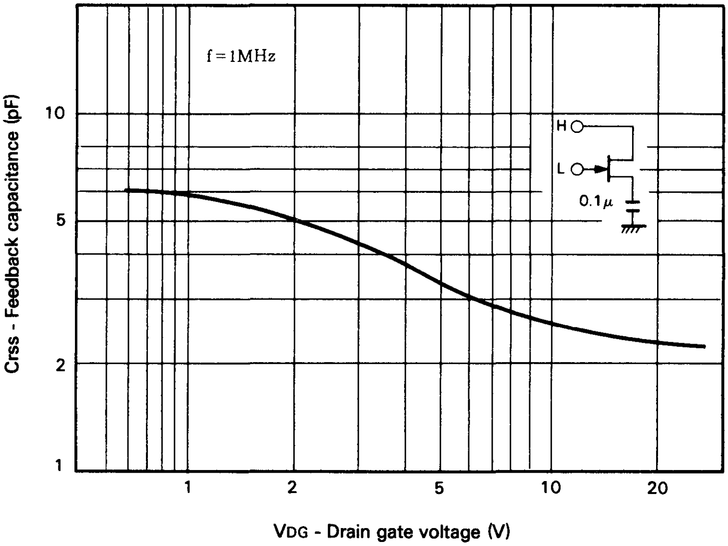


Drain current vs. Gate source voltage

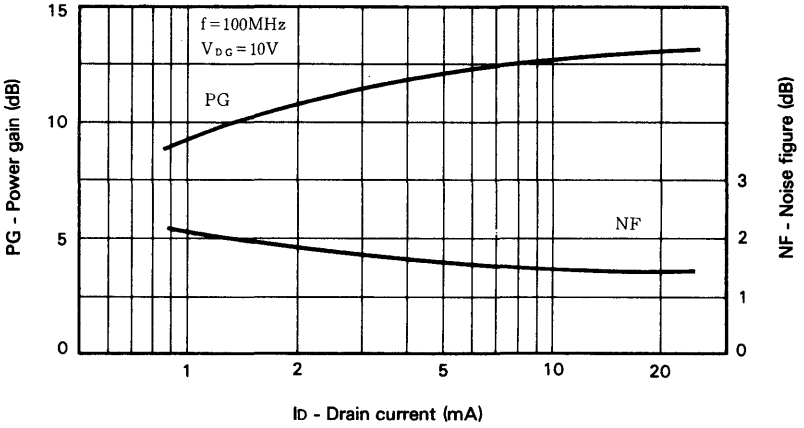


Forward transfer admittance vs. Gate source voltage

Feedback capacitance vs. Drain gate voltage

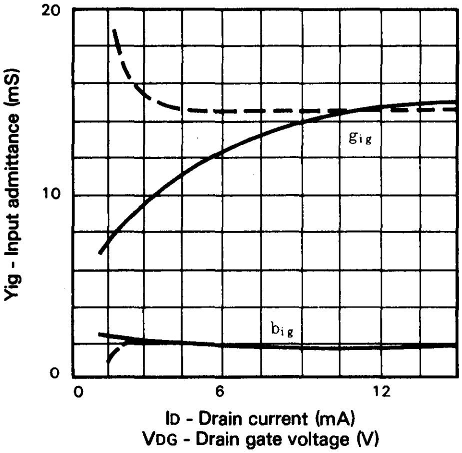


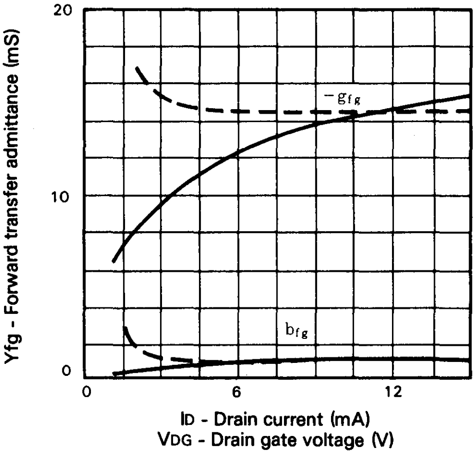
Common-gate power gain noise figure vs. Drain current

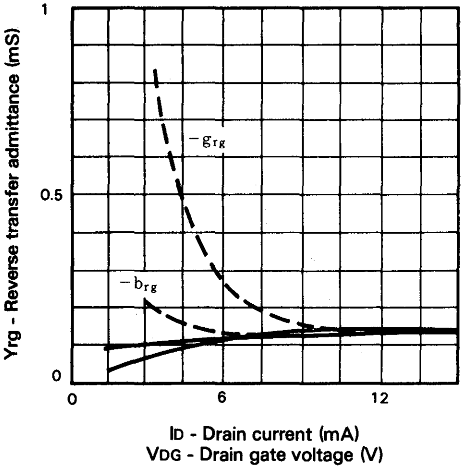


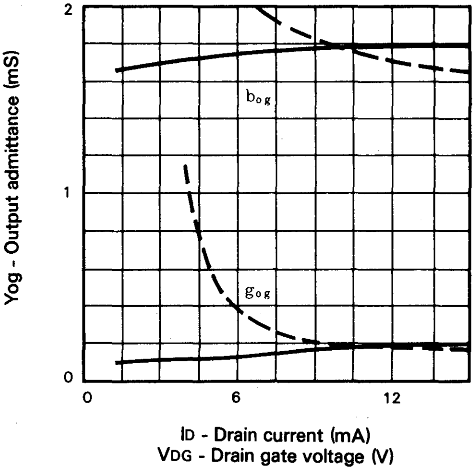
Common Gate Y-Parameter

——— Drain current characteristics (VDG = 10V, f = 100 MHz)
— — — Drain gate voltage characteristics (ID = 10mA, f = 100 MHz)


Input admittance

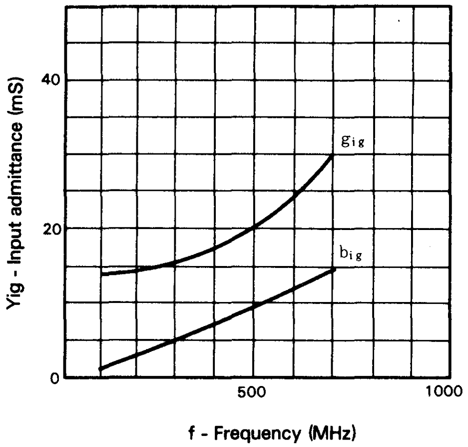

Forward transfer admittance


Reverse transfer admittance

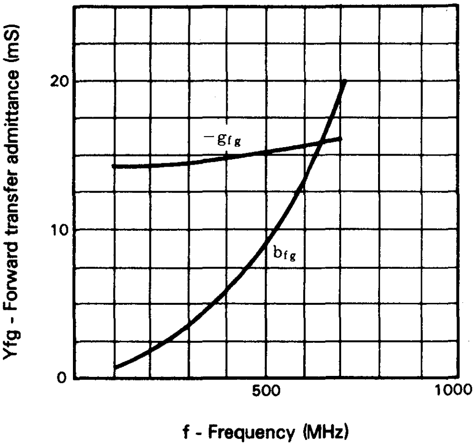

Output admittance

Common Gate Y-Parameter vs. Frequency (VDG = 10V, ID = 10mA)

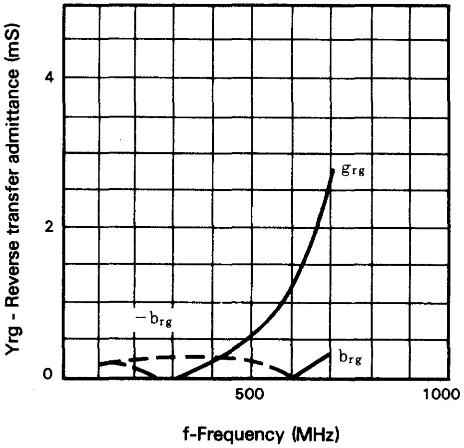
Input admittance



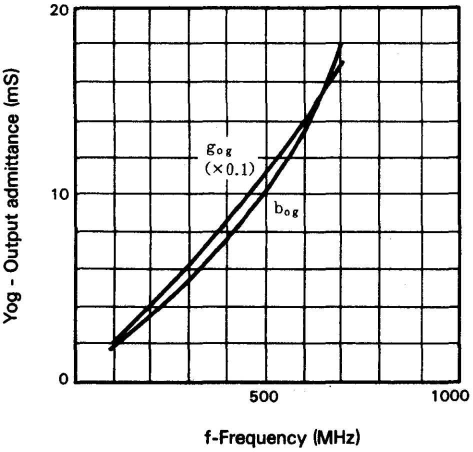
Forward transfer admittance



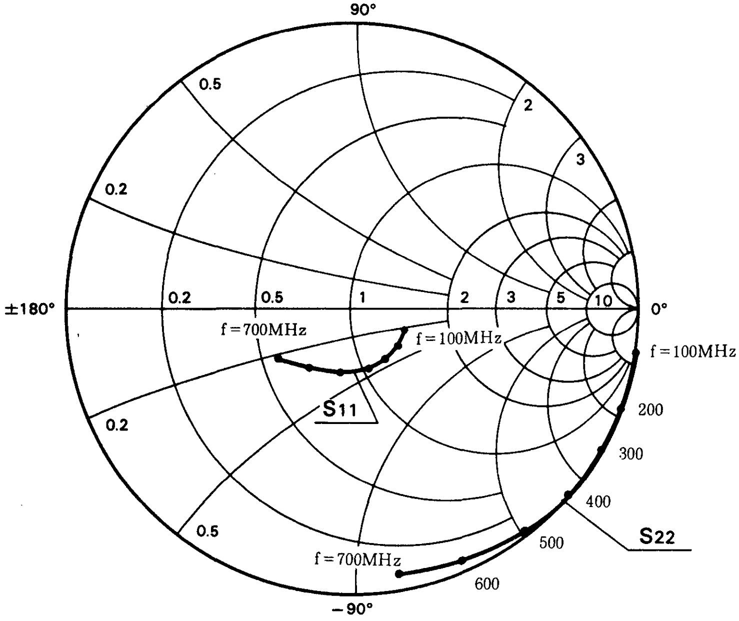
Reverse transfer admittance

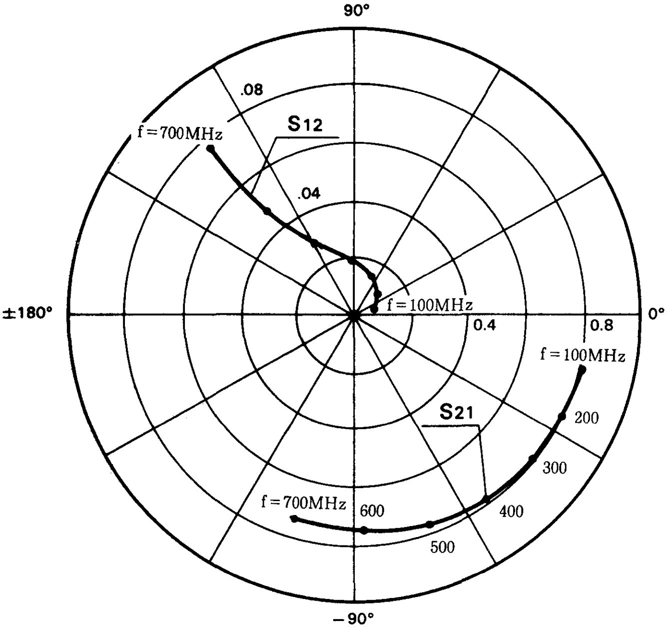


Output admittance

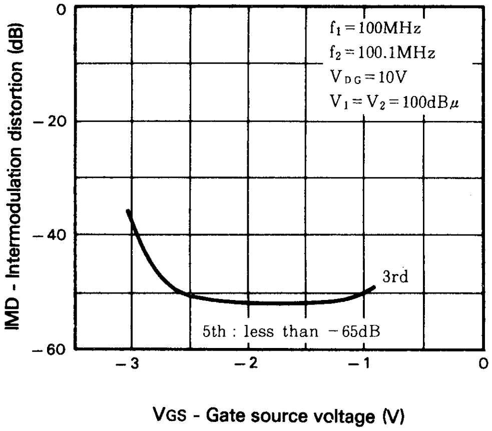


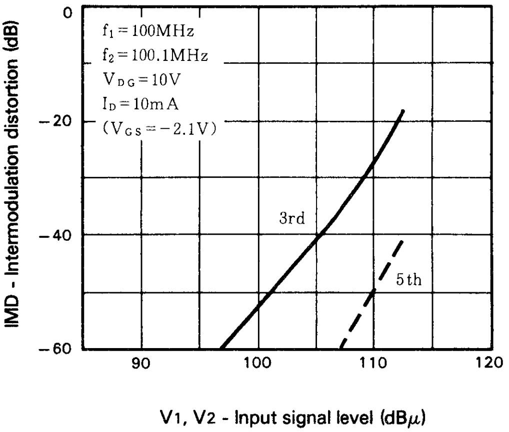
Common Gate S-Parameter vs. Frequency (VDG = 10V, ID = 10 mA)



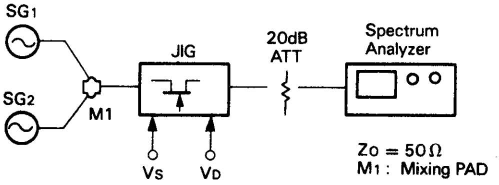


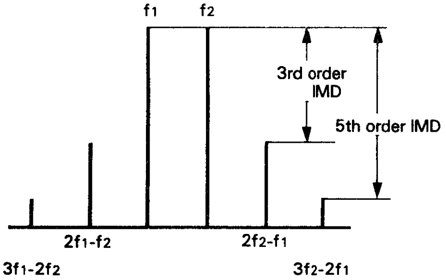
Intermodulation distortion characteristics



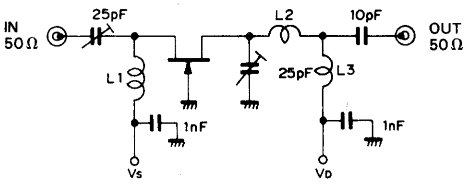


Block Diagram for IMD Measurement



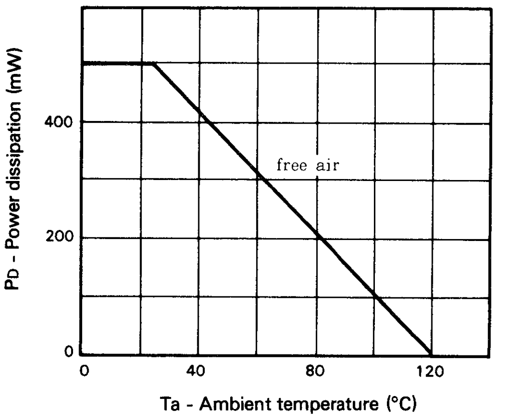


100 MHz IMD Test Circuit



L1 : 0.45 ϕmm polyurethane wire 3ϕ mm 10.5 t
L2, L3 : 0.45 ϕmm polyurethane wire 3ϕ mm 5.5 t

Derating curve



SONY **2SK152**

Silicon N-Channel Junction FET

Description

The 2SK152 is the first device to reach such a high "Figure of merit" level. Because it uses the latest Epitaxy and Pattern technology.

Head amplifiers Video Cameras VTRs etc. perform very efficiently.

Features

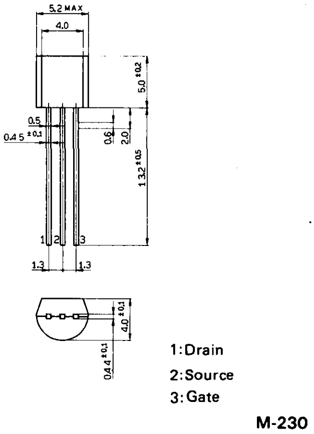
- High figure of merit
  $V_{DS}=5V$ $|Y_{fs}|/C_{iss}$ 3.5 (Typ.)
  $I_D=10mA$
- High $|Y_{fs}|$
  $V_{DS}=5V$ $|Y_{fs}|$ 30mS (Typ.)
  $V_{GS}=0V$
- Low input capacitance
  C_{iss} 8pF (Typ.)

Structure

Silicon N-Channel junction FET.

Package Outline

Unit: mm



Absolute Maximum Ratings (Ta = 25°C)

• Drain to gate voltage	V_{DGO}	15	V
• Source to gate voltage	V_{SGO}	15	V
• Drain current	I_D	50	mA
• Gate current	I_G	5	mA
• Junction temperature	T_j	100	°C
• Storage temperature	T_{stg}	−50 to +120	°C
• Allowable power dissipation	P_D	300	mW

Electrical Characteristics

Ta = 25°C

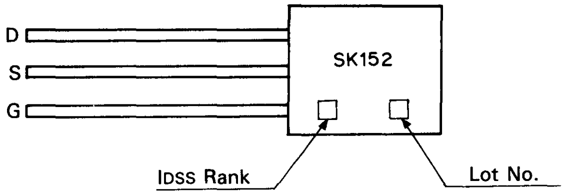
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain to gate voltage	V_{DGO}	$I_G = 10\mu A$	15			V
Source to gate voltage	V_{SGO}	$I_G = 10\mu A$	15			V
Gate cutoff current	I_{GSS}	$V_{GS} = -7V$, $V_{DS} = 0V$			−2	nA
Drain current	I_{DSS}	$V_{DS} = 5V$, $V_{GS} = 0V$	9.5		42	mA*
Gate to source cutoff voltage	$V_{GS(OFF)}$	$V_{DS} = 5V$, $I_D = 100\mu A$	−0.55		−2.0	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	$V_{DS} = 5V$, $V_{GS} = 0V$, $f = 1kHz$	21	30		mS
Input capacitance	C_{iss}	$V_{DS} = 5V$, $V_{GS} = 0V$, $f = 1MHz$		8	9	pF

*Note) Drain current detail specification as follows.

Classification

Rank	I_{DSS}(mA) $V_{DS} = 5V$ $V_{GS} = 0V$
1	9.5 to 14.8
2	13.4 to 21.0
3	19.0 to 30.2
4	27.4 to 42.0

Mark

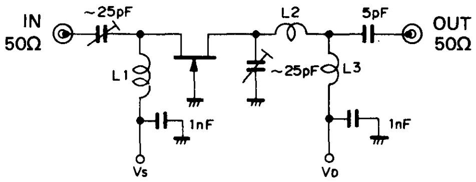


Standard Circuit Design Data

Ta = 25°C

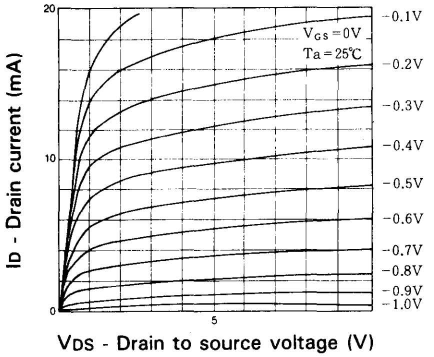
Item	Symbol	Condition	Typ.	Unit
Forward transfer admittance	$\|Y_{fs}\|$	V_{DS} = 5V, I_D = 10mA, f = 1kHz	25	mS
Input capacitance	C_{iss}	V_{DS} = 5V, I_D = 10mA, f = 1MHz	7.2	pF
Gate cutoff current	I_G	V_{DG} = 5V, I_D = 10mA	40	pA
Input resistance	r_{is}	V_{DS} = 5V, I_D = 10mA, f = 100MHz	3.5	kΩ
Input capacitance	C_{is}		7.2	pF
Output resistance	r_{os}		3	kΩ
Output capacitance	C_{os}		2.5	pF
Power gain	PG	V_{DS} = 5V, I_D = 10mA, f = 100MHz	15	dB
Noise figure	NF		1.8	dB
Equivalent input noise voltage	$\bar{e}_n$	V_{DS} = 5V, I_D = 10mA f = 1kHz, R_g = 0Ω	1.2	nV/√Hz
Reverse transfer capacitance	C_{rss}	V_{DS} = 5V, V_{GS} = 0V, f = 1MHz	2.0	pF

100 MHz PG, NF Test Circuit

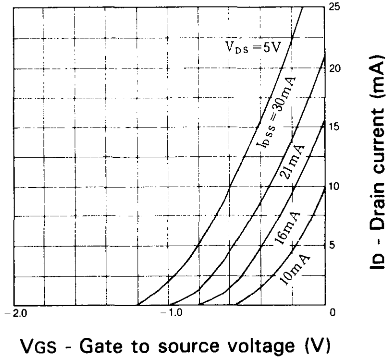


L1 φ0.45mm Polyurethane Wireφ3mm 10.5t
L2
L3 } φ0.45mm Polyurethane Wireφ3mm 5.5t

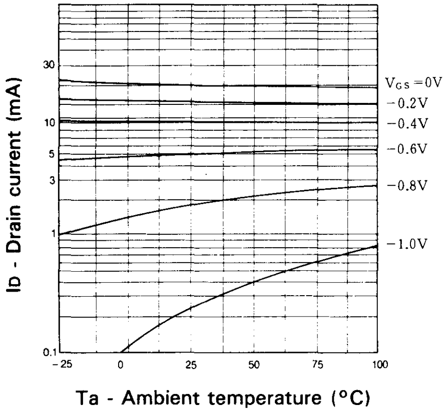
Drain current vs. Drain to source voltage



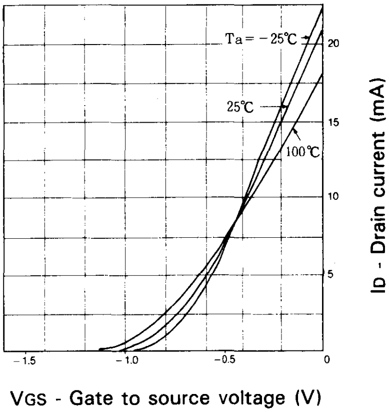
Drain current vs. Gate to source voltage



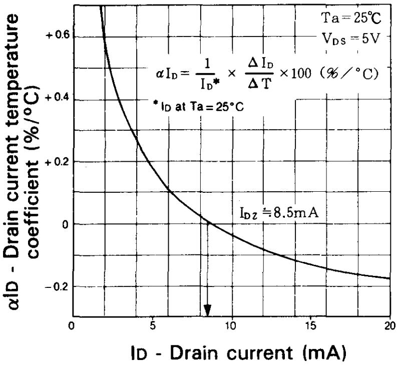
Drain current vs. Ambient temperature



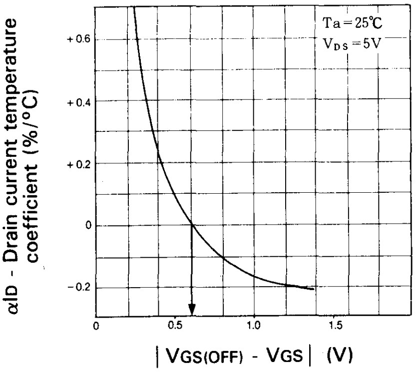
Transfer characteristics vs. Ambient temperature



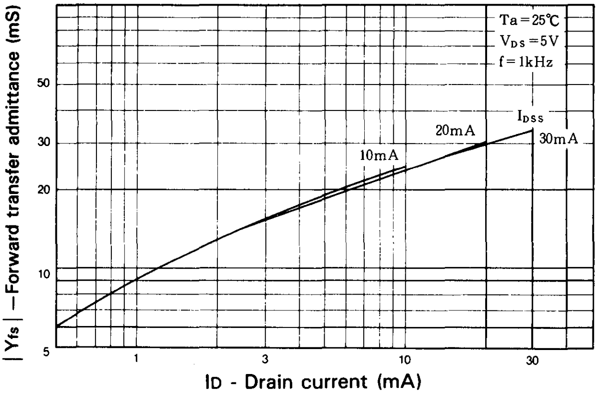
Drain current temperature coefficient vs. Drain current



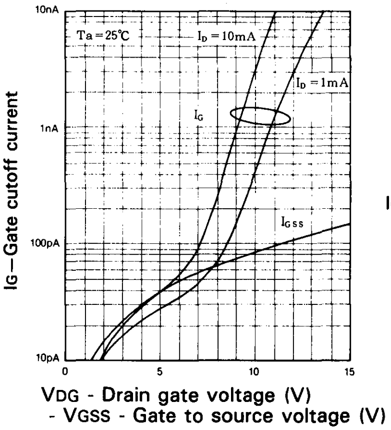
Drain current temperature coefficient vs. Gate cutoff voltage

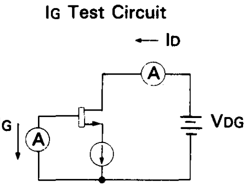


Forward transfer admittance vs. Drain current

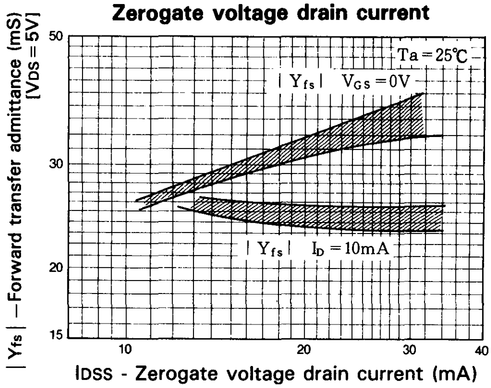


Gate cutoff current vs. Bias voltage

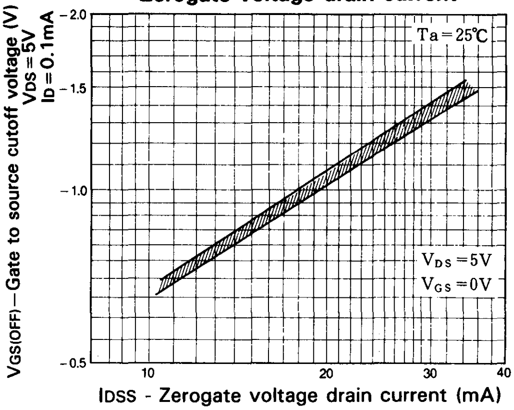




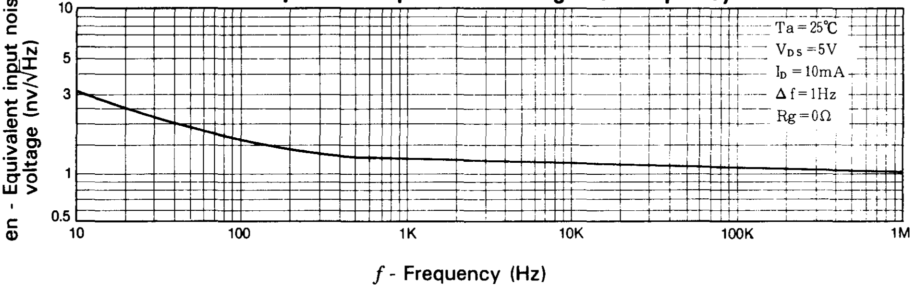
Forward transfer admittance vs. Zerogate voltage drain current



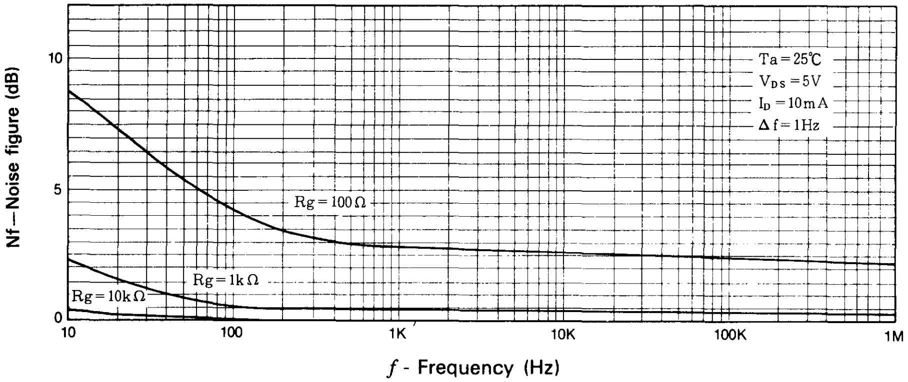
Gate to source cutoff voltage vs. Zerogate voltage drain current



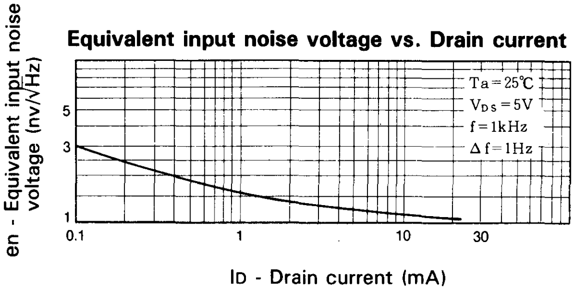
Equivalent input noise voltage vs. Frequency



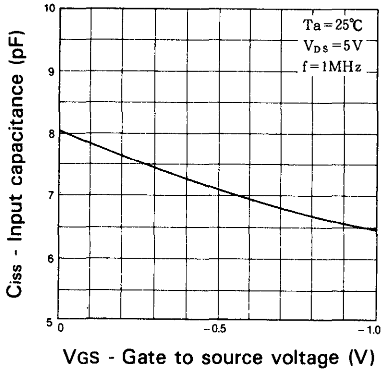
Noise figure vs. Frequency



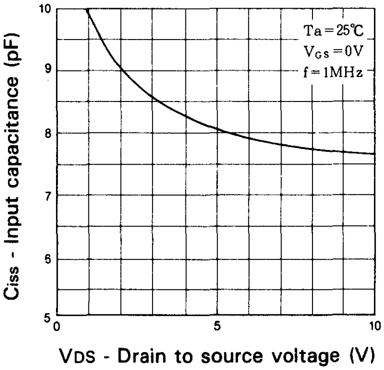
Equivalent input noise voltage vs. Drain current



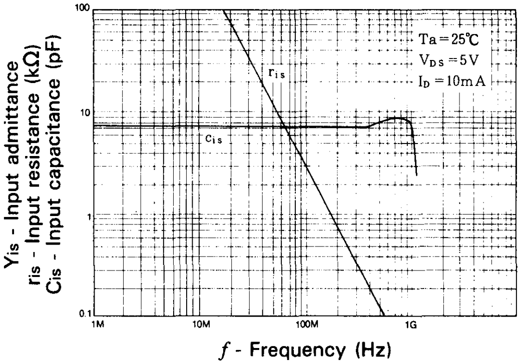
Input capacitance vs. Gate to source voltage



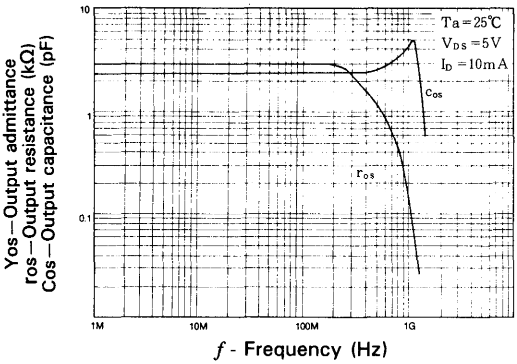
Input capacitance vs. Drain to source voltage



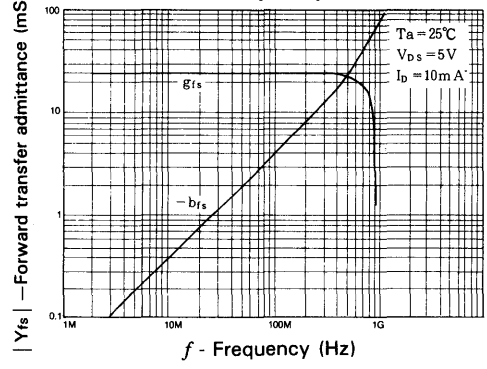
Input admittance vs. Frequency



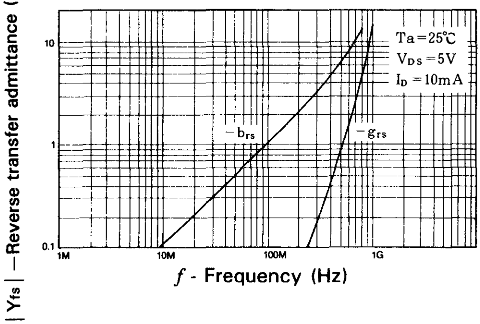
Output admittance vs. Frequency



Forward transfer admittance vs. Frequency



Reverse transfer admittance vs. Frequency



SONY 2SK300

Silicon N-Channel Junction FET

Description

The 2SK300 is the first device to reach such a high "Figure of merit" level. Because it uses the latest Epitaxy and Pattern technology.

Head Amplifiers Video Cameras VTRs etc. perform very efficiently.

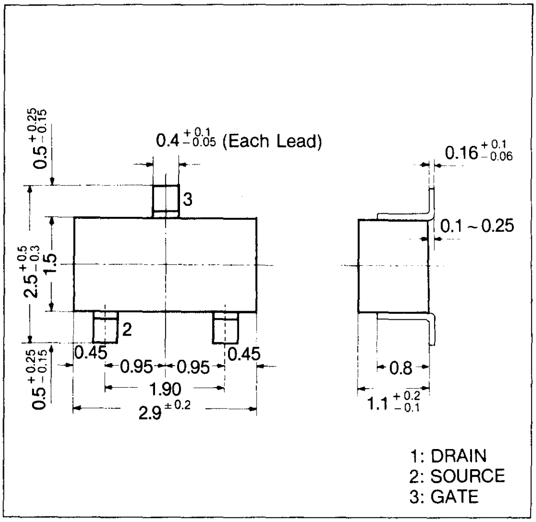
Features

•High figure of merit	$V_{DS}=5V$ $I_D=10mA$	$\|Y_{fs}\|/Ciss$	3.5 (Typ)
•High $\|Y_{fs}\|$	$V_{DS}=5V$ $V_{GS}=0V$	$\|Y_{fs}\|$	30mS (Typ.)
•Low Ciss		Ciss	8pF (Typ.)

Structure

- •Silicon N-channel Junction FET.

Package Outline unit: mm



Absolute Maximum Ratings (Ta = 25°C)

•Drain to Gate voltage	V_{DGO}	15	V
•Source to Gate voltage	V_{SGO}	15	V
•Drain current	I_D	50	mA
•Gate current	I_G	5	mA
•Allowable power dissipation	P_D	150	mW
•Junction temperature	T_j	100	°C
•Storage temperature	T_{stg}	−50 to +120	°C

Electrical Characteristics

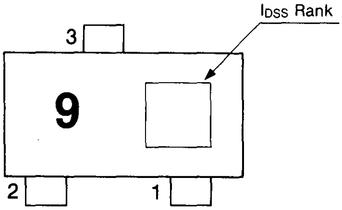
(Ta = 25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain to Gate Voltage	V_{DGO}	$I_G = 10\mu A$	15			V
Source to Gate Voltage	V_{SGO}	$I_G = 10\mu A$	15			V
Gate Cutoff Current	I_{GSS}	$V_{GS} = -7V$, $V_{DS} = 0V$			−2	nA
Drain Current	I_{DSS}	$V_{DS} = 5V$, $V_{GS} = 0V$	9.5		42	mA*1
Source to Gate Cutoff Voltage	$V_{GS(OFF)}$	$V_{DS} = 5V$, $I_D = 100\mu A$	−0.55		−2.0	V
Forward Transfer Admittance	$\lvert Y_{fs} \rvert$	$V_{DS} = 5V$, $V_{GS} = 0V$, f = 1kHz	21	30		ms
Input Capacitance	Ciss	$V_{DS} = 5V$, $V_{GS} = 0V$, f = 1MHz		8	9	pF

*1 Drain current detail specification as follows.

Rank	I_{DSS} (mA) $\left(\begin{matrix}V_{DS}=5V\\V_{GS}=0V\end{matrix}\right)$
1	9.5 ~ 14.8
2	13.4 ~ 21.0
3	19.0 ~ 30.2
4	27.4 ~ 42.0

Mark



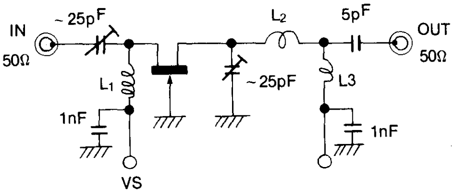
1. Drain
2. Source
3. Gate

Standard Circuit Design Note

(Ta = 25°C)

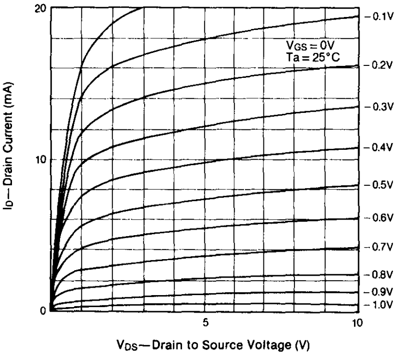
Item	Symbol	Condition	Typ.	Unit
Forward Transfer Admittance	$\lvert Y_{fs} \rvert$	$V_{DS}=5V$ $I_D=10mA$ $f=1kHz$	25	mS
Input Capacitance	Ciss	$V_{DS}=5V$ $I_D=10mA$ $f=1MHz$	7.2	pF
Gate Cutoff Current	I_G	$V_{DG}=5V$ $I_D=10mA$	40	pA
Input Resistance	ris	$V_{DS}=5V$ $I_D=10mA$ $f=100MHz$	3.5	kΩ
Input Capacitance	Cis		7.2	pF
Output Resistance	ros		3	kΩ
Output Capacitance	Cos		2.5	pF
Power Gain	PG	$V_D=5V$ $I_D=10mA$ $f=100MHz$	15	dB
Noise Figure	NF		1.8	dB
Equivalent Input Noise Voltage	$\bar{e}n$	$V_{DS}=5V$ $I_D=10mA$ $f=1kHz$ $R_g=0\Omega$	1.2	$nV/\sqrt{Hz}$
Reverse Transfer Capacitance	Crss	$V_{DS}=5V$ $V_{GS}=0V$ $f=1MHz$	2.0	pF

100MHz PG, NF Test Circuit

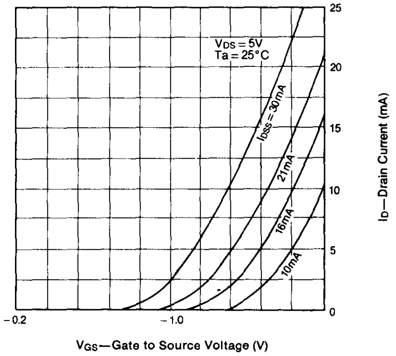


L_1 ϕ0.45mm Polyurethane Wireϕ3mm 10.5t
L_2, L_3 ϕ0.45mm Polyurethane Wireϕ3mm 5.5t

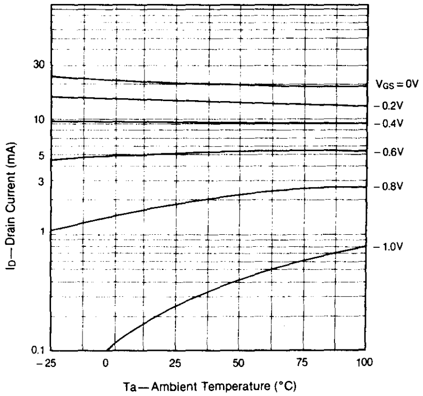
Drain Current vs. Drain to Source Voltage



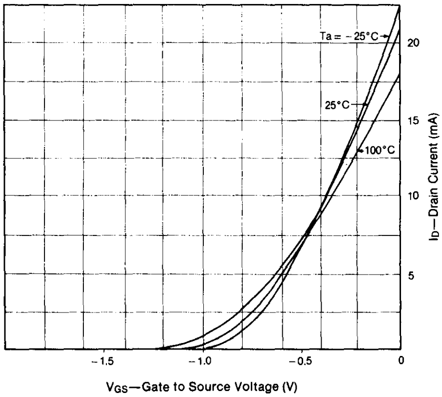
Drain Current vs. Gate to Source Voltage



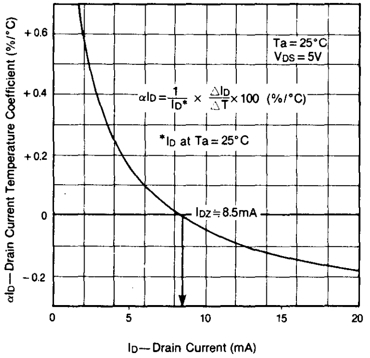
Drain Current vs. Ambient Temperature



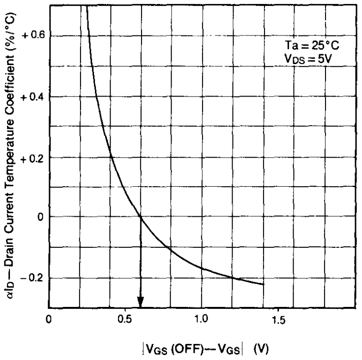
Transfer Characteristics vs. Ambient Temperature



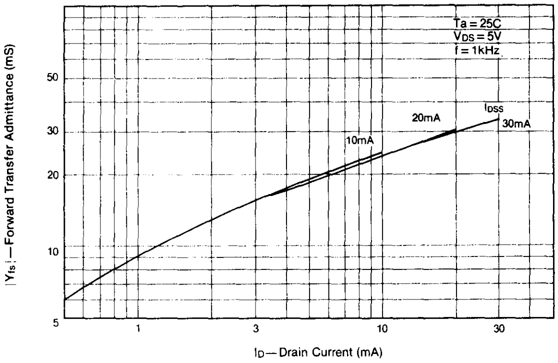
Drain Current Temperature Coefficient
vs.
Drain Current



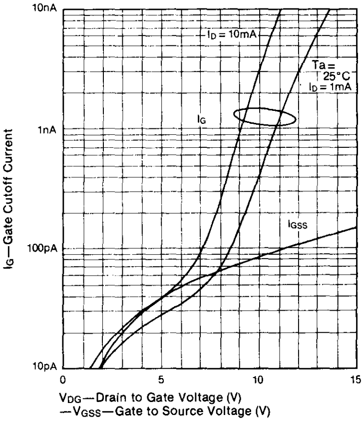
Drain Current Temperature Coefficient
vs.
Gate Cutoff Voltage



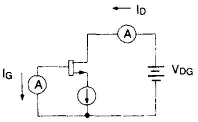
Forward Transfer Admittance vs. Drain Current



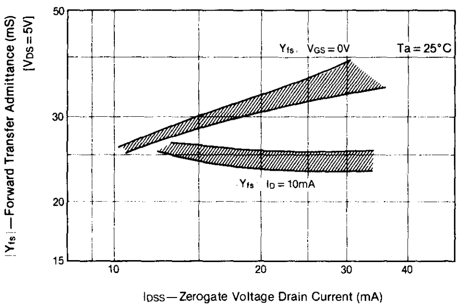
Gate Cutoff Current vs. Supply Voltage



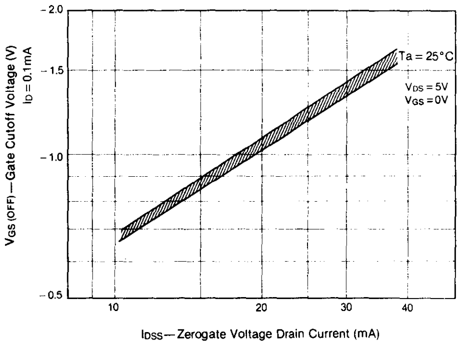
IG Test Circuit

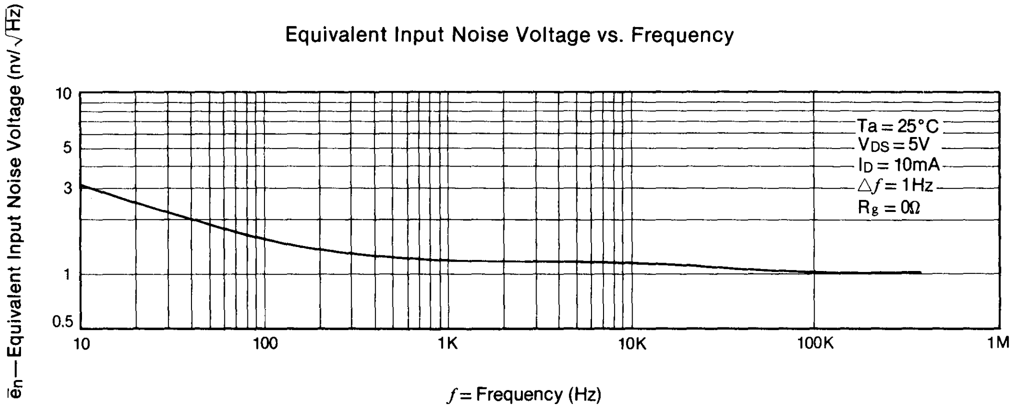


Forward Transfer Admittance
vs.
Zerogate Voltage Drain Current

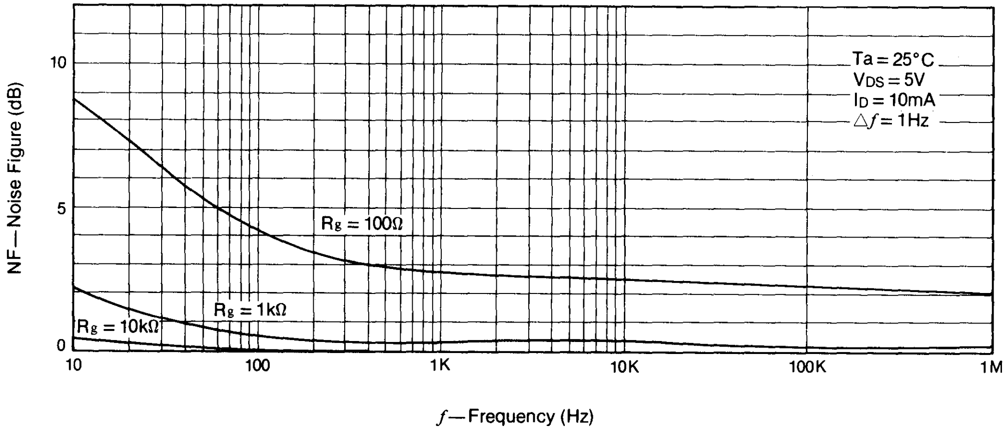


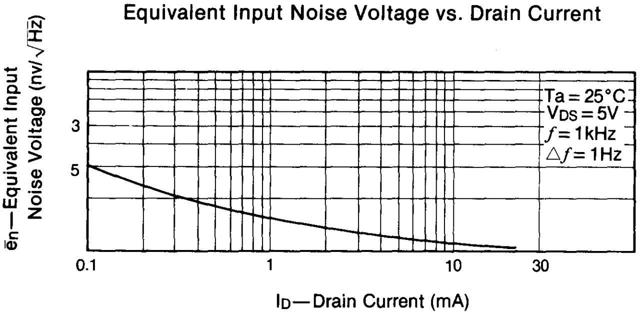
Gate Cutoff Voltage
vs.
Zerogate Voltage Drain Current



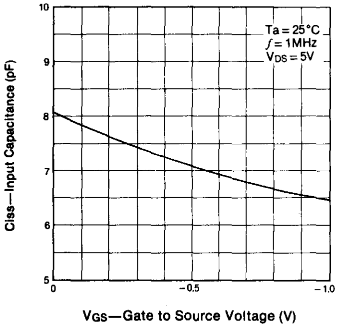

Equivalent Input Noise Voltage vs. Frequency

Noise Figure vs. Frequency

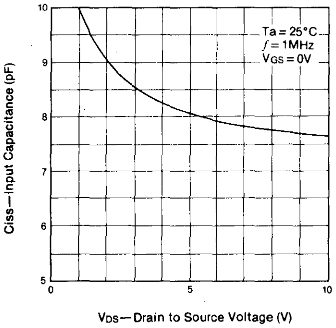



Equivalent Input Noise Voltage vs. Drain Current

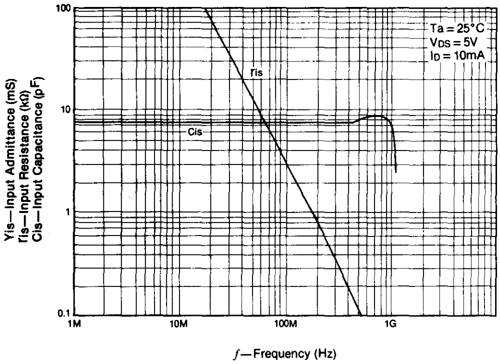
Input Capacitance vs. Gate to Source Volgate



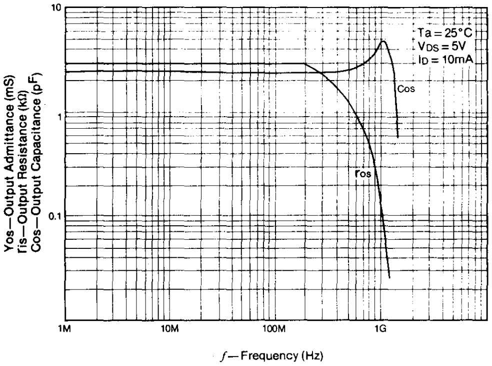
Input Capacitance vs. Drain to Source Voltage



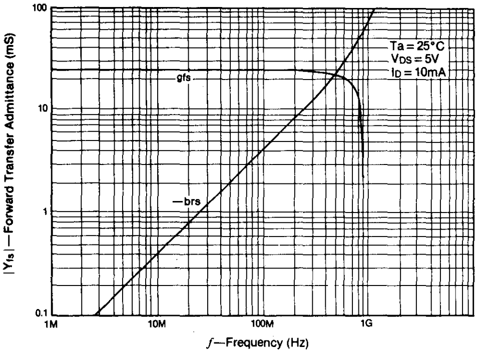
Input Admittance vs. Frequency



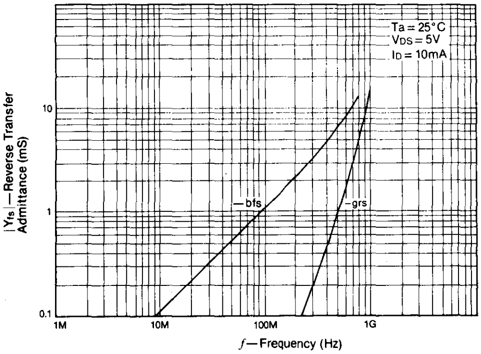
Output Admittance vs. Frequency



Forward Transfer Admittance vs. Frequency



Reverse Transfer Admittance vs. Frequency



2SK676

AlGaAs/GaAs Low Noise Microwave HEMT

Description

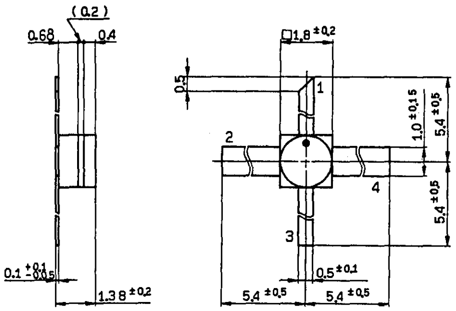
The 2SK676 is an AlGaAs/GaAs HEMT fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception (DBS, FSS, TVRO) and other communications systems.

Structure

AlGaAs/GaAs N-Channel HEMT

Package Outline

Unit: mm



1 : Gate
2 : Source
3 : Drain
4 : Source

Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	70	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	−55 to +150	°C
• Allowable power dissipation	P_D	340	mW

Electrical Characteristics

Ta=25°C

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−100	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		10	40	70	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	V_{DS}=2V, I_D=10mA		25	40		mS
Noise figure	NF	V_{DS}=2V, I_D=10mA	f=4GHz			0.7	dB
			f=12GHz			1.4	
Associated gain at NF Min.	Ga	V_{DS}=2V I_D=10mA	f=4GHz	12	14		dB
			f=12GHz	9	11		

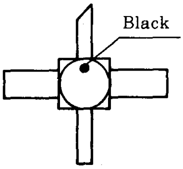
Classification

f=12 GHz

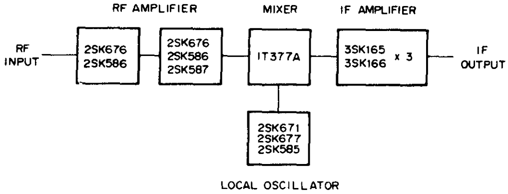
Rank	Min.	Typ.	Max.	Unit
2SK676-1	−	−	1.0	dB
2SK676-2	−	−	1.2	
2SK676-3	−	−	1.4	

Die and packaged devices available.

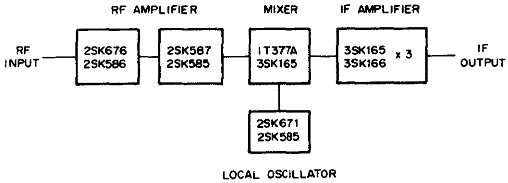
Mark



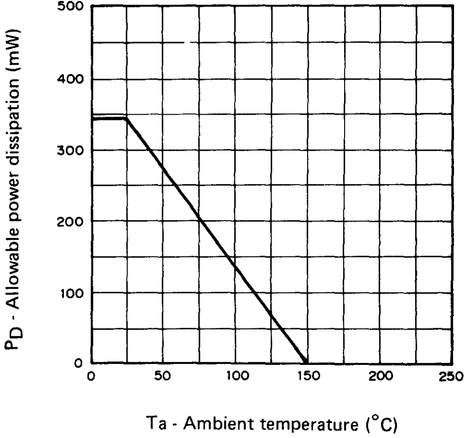
X-Band, and K-Band Downconverter Block Diagram



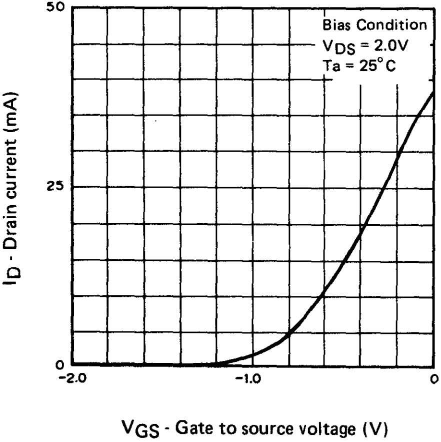
C-Band Downconverter Block Diagram



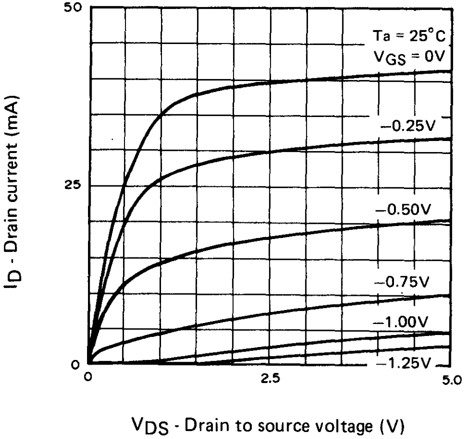
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

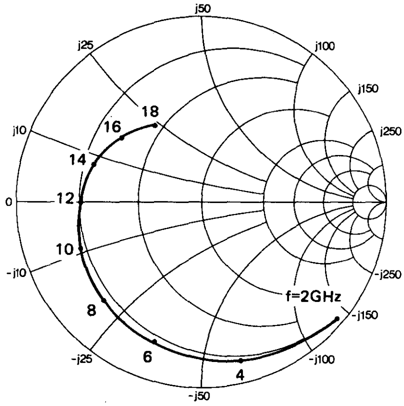


S-Parameter vs. Frequency Characteristics

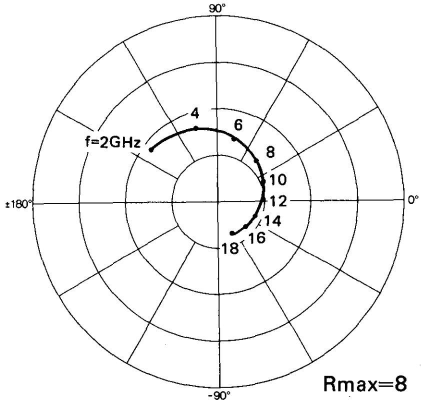
V_{DS}=2V, I_D=10 mA

f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.00	.964	−40	3.688	142	.028	62	.776	−27
3.00	.926	−58	3.504	124	.038	51	.757	−40
4.00	.885	−76	3.297	107	.047	37	.742	−53
5.00	.841	−93	3.060	91	.050	27	.724	−65
6.00	.803	−109	2.834	76	.052	19	.710	−77
7.00	.773	−123	2.617	62	.052	12	.703	−88
8.00	.748	−136	2.416	48	.051	8	.708	−99
9.00	.726	−147	2.243	36	.049	4	.712	−108
10.00	.706	−159	2.108	24	.048	4	.718	−117
11.00	.683	−169	1.995	12	.048	2	.724	−127
12.00	.663	−180	1.891	1	.048	4	.730	−136
13.00	.642	171	1.786	−11	.051	4	.740	−145
14.00	.620	161	1.711	−22	.057	4	.756	−153
15.00	.595	152	1.649	−32	.062	2	.772	−161
16.00	.564	143	1.599	−43	.068	−1	.788	−168
17.00	.528	133	1.583	−54	.076	−6	.799	−176
18.00	.487	123	1.549	−66	.086	−13	.809	176

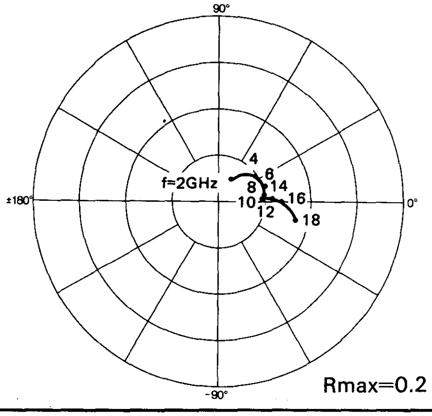
S_{11}



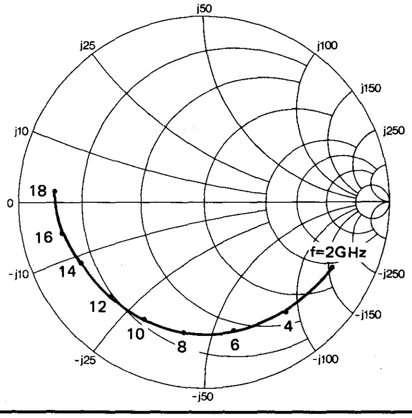
S_{21}



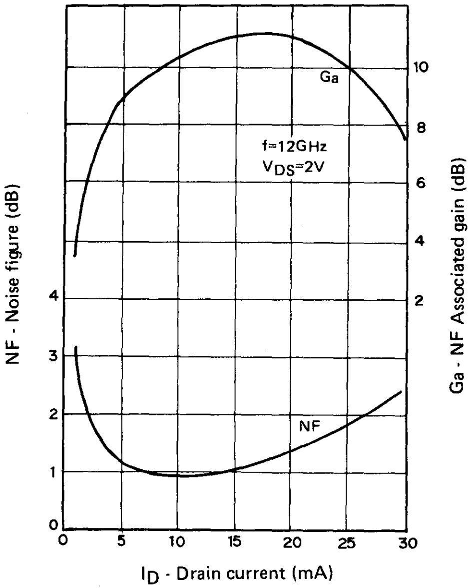
S_{12}



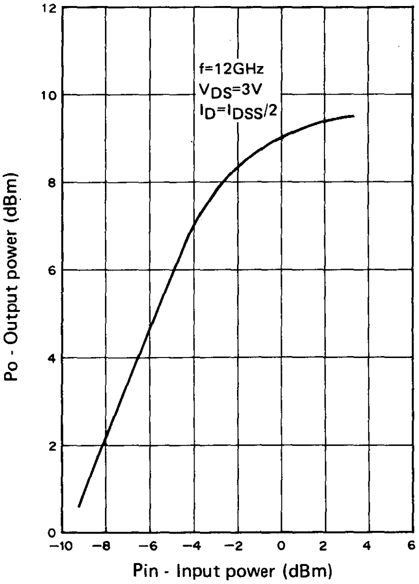
S_{22}



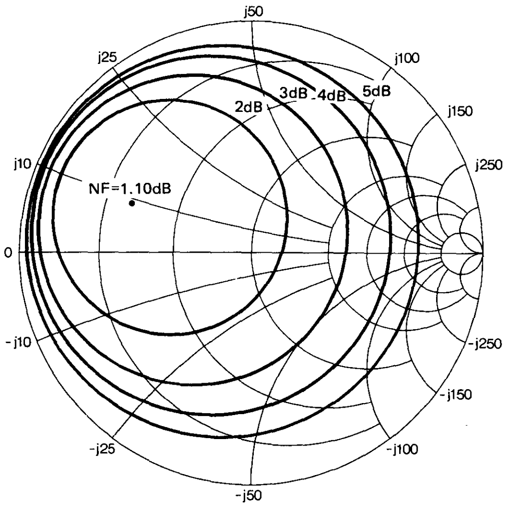
Minimum noise figure vs. Drain current



Output power at 1 dB gain compression



Noise Figure Characteristics



NFmin=1.10dB
at Gamma=0.568
Angle=157.7

f=12GHz
V_{DS}=2V
I_D=10mA

NF, Ga, Gamma Optimum Characteristics (V_{DS}=2V, I_D=10 mA)

Frequency (GHz)	NF (dB)	Ga (dB)	Gamma Optimum	
			MAG	ANG
12	1.10	11.8	0.568	157.7

SONY 2SK677

AlGaAs/GaAs Low Noise Microwave HEMT

Description

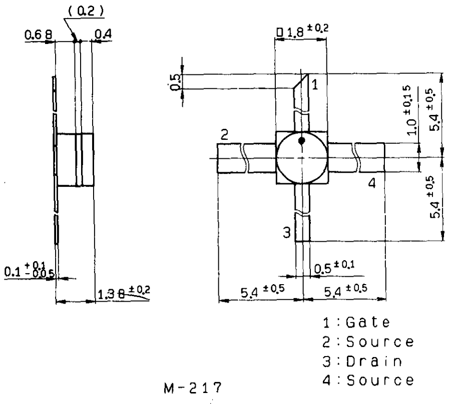
The 2SK677 is an AlGaAs/GaAs HEMT fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception (DBS, FSS, TVRO) and other communications systems.

Structure

AlGaAs/GaAs N-Channel HEMT

Package Outline

Unit: mm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	100	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	−55 to +150	°C
• Allowable power dissipation	P_D	340	mW

Electrical Characteristics

(Ta=25°C)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−150	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		15	60	100	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	$\|Y_{fs}\|$	V_{DS}=2V, I_D=15mA		37	60		mS
Noise figure	NF	V_{DS}=2V, I_D=15mA	f=4GHz			0.7	dB
			f=12GHz*			1.4	
Associated gain at NF min.	Ga	V_{DS}=2V I_D=15mA	f=4GHz	12	14		dB
			f=12GHz	9	11		

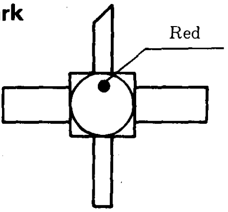
* Classification (f=12 GHz)

Rank	Min.	Typ.	Max.	Unit
2SK677-1	–	–	1.0	dB
2SK677-2	–	–	1.2	
2SK677-3	–	–	1.4	

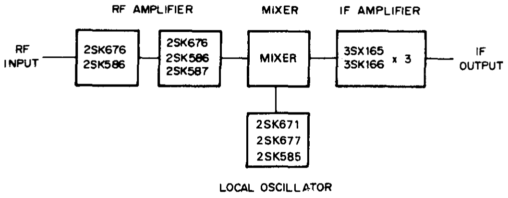
V_{DS}=2V
I_D=15mA

Die and packaged devices available.

Mark

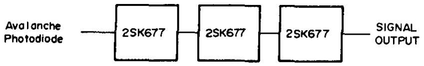


X-Band, and K-Band Downconverter Block Diagram

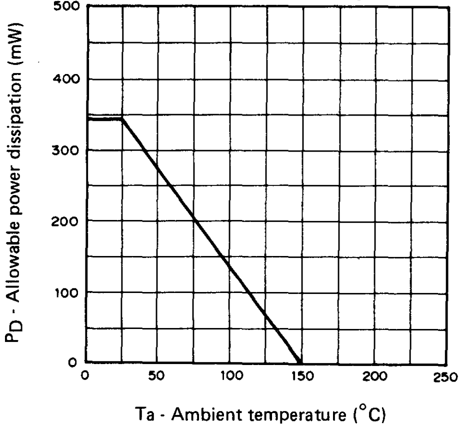


Wideband Microwave Amplifier (1-5 GHz)

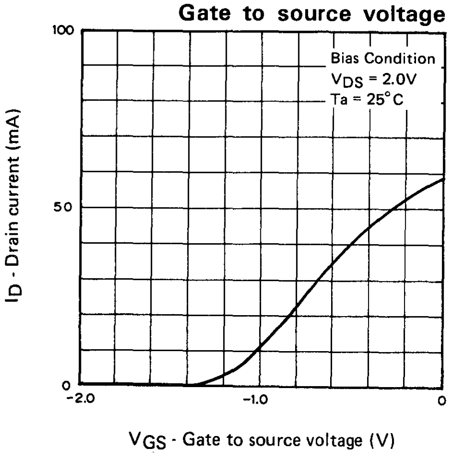
(preamplifier for optical detector system)



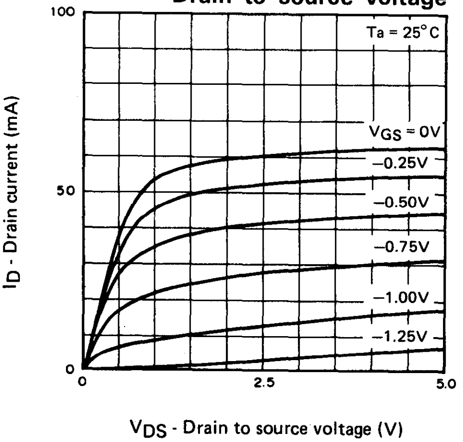
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

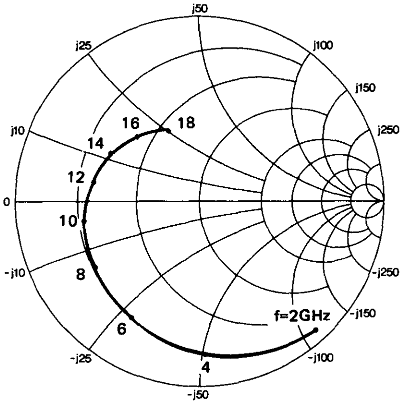


S-Parameter vs. Frequency Characteristics

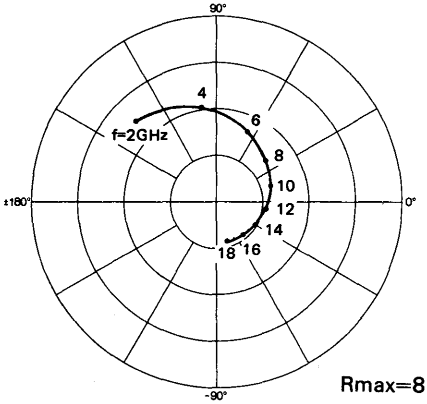
(VDS=2V, ID=15 mA)

f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.00	.937	−48	4.911	136	.031	58	.696	−31
3.00	.879	−69	4.509	117	.042	46	.670	−46
4.00	.825	−88	4.099	99	.049	36	.646	−59
5.00	.771	−106	3.692	82	.052	26	.625	−72
6.00	.729	−121	3.337	67	.054	19	.611	−84
7.00	.699	−135	3.025	53	.053	16	.609	−96
8.00	.674	−148	2.753	40	.054	13	.615	−107
9.00	.653	−159	2.533	28	.054	12	.625	−118
10.00	.634	−169	2.365	16	.056	10	.633	−127
11.00	.611	−180	2.220	4	.060	10	.645	−137
12.00	.590	170	2.090	−8	.067	11	.652	−147
13.00	.570	161	1.973	−19	.072	8	.665	−157
14.00	.545	152	1.881	−30	.079	4	.687	−165
15.00	.517	143	1.808	−41	.091	−1	.707	−174
16.00	.484	134	1.750	−52	.101	−6	.723	179
17.00	.449	124	1.725	−64	.113	−14	.730	170
18.00	.408	114	1.677	−75	.125	−22	.741	161

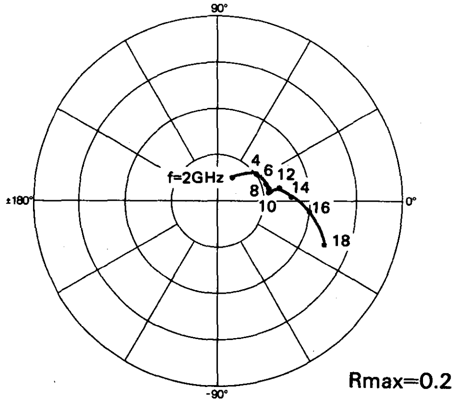
S_{11}



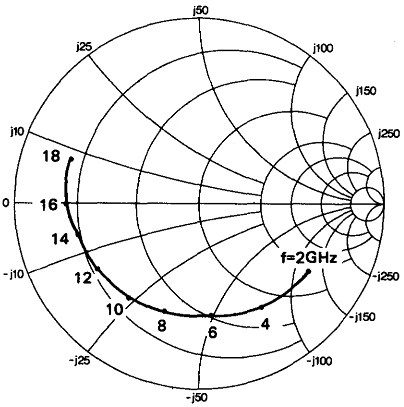
S_{21}



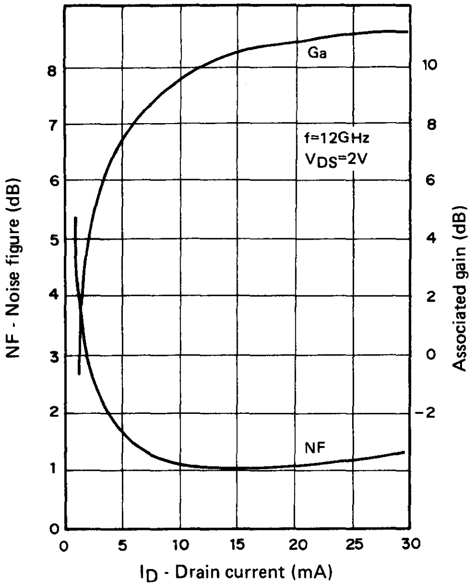
S_{12}



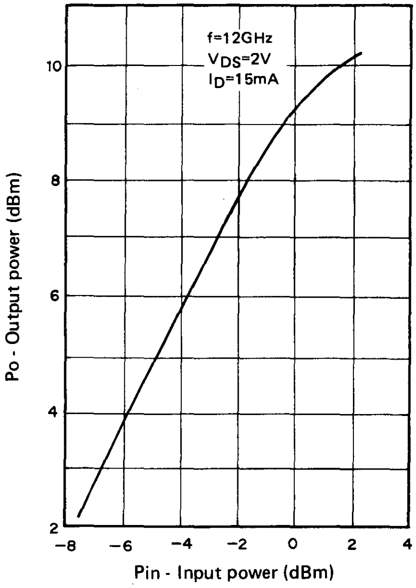
S_{22}



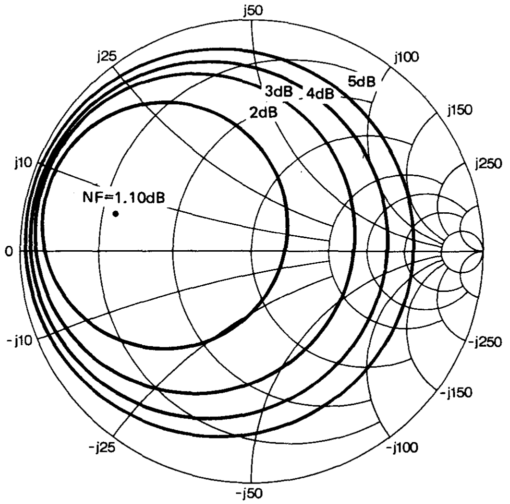
Minimum noise figure vs. Drain current



Output Power at 1 dB gain compression



Noise figure characteristics



NFmin=1.10dB
at Gamma=0.614
Angle=163.1

f=12GHz
VDS=2V
ID=15mA

NF, Ga, Gamma Optimum Characteristics (VDS=2V, ID=15 mA)

Frequency (GHz)	NF (dB)	Ga (dB)	Gamma Optimum	
			MAG	ANG
12	1.10	10.2	0.614	163.1

SONY 2SK676H5

AlGaAs/GaAs Low Noise Microwave HEMT CHIP **Preliminary**

Description

The 2SK676H5 is an AlGaAs/GaAs HEMT chip fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception and other communications systems up to K-band.

Features

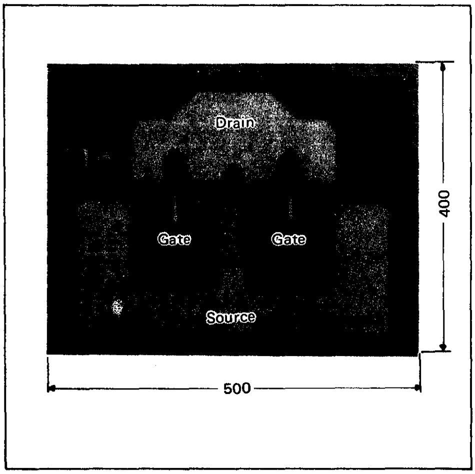
- Low noise figure
- Excellent device uniformity
- High gain
- Wide band

Structure

AlGaAs/GaAs N-channel HEMT chip
Twin gate-pad π geometry

Chip outline

Unit: μm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	70	mA

Electrical Characteristics

Ta=25°C

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−100	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		10	40	70	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	Y_{fs}	V_{DS}=2V, I_D=10mA		25	40		ms
Noise figure	NF	V_{DS}=2V, I_D=10mA	f=12GHz			1.4	dB
Associated gain at NF min.	Ga	V_{DS}=2V I_D=10mA	f=12GHz	9	11		dB

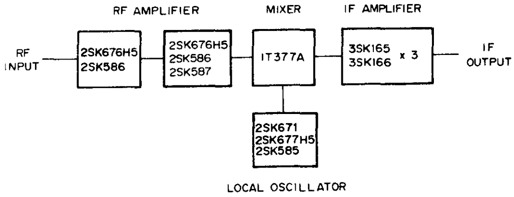
Noise figure ranks determined on a sampling basis by measuring ceramic-mounted devices.

Noise Figure Classification (f=12 GHz)

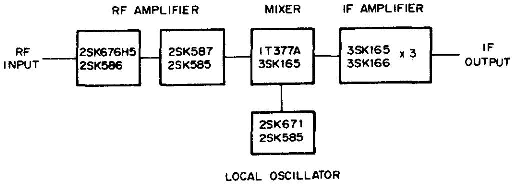
	Min.	Typ.	Max.	
2SK676H5-1	—	—	1.0	dB
2SK676H5-2	—	—	1.2	
2SK676H5-3	—	—	1.4	

V_{DS}=2V
I_D=10mA

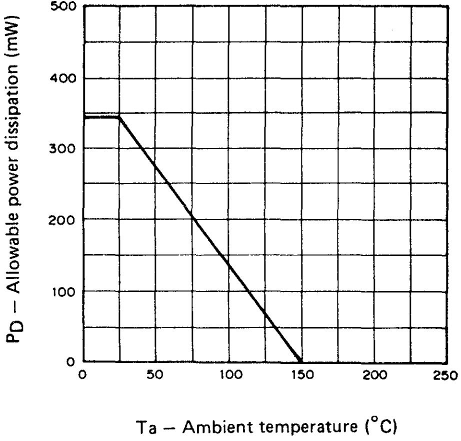
X-Band, and K-Band Downconverter Block Diagram



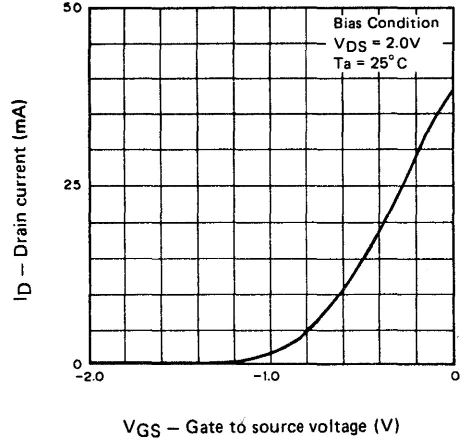
C-Band Downconverter Block Diagram



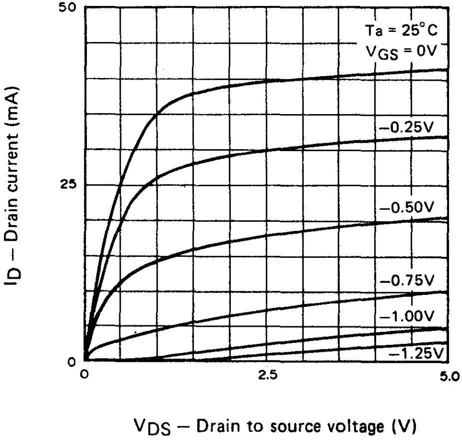
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

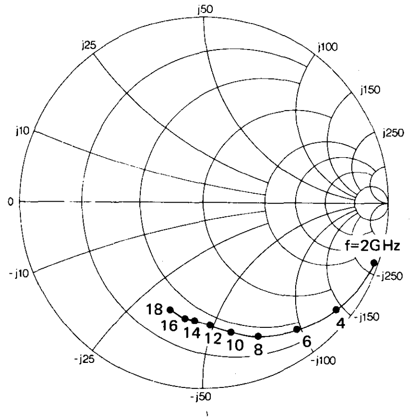


S-Parameters vs. Frequency Characteristics

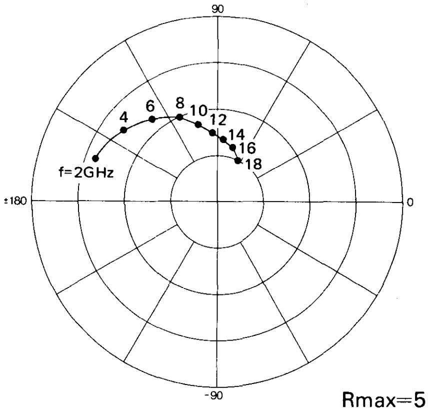
VDS=2V, ID=10 mA

f (GHz)	S11		S21		S12		S22	
	MAG	ANG.	MAG	ANG	MAG	ANG	MAG	ANG
2	0.976	−20.0	3.415	161.1	0.030	79.2	0.744	−10.1
4	0.916	−38.6	3.164	143.8	0.057	69.8	0.723	−19.0
6	0.852	−54.2	2.819	129.4	0.076	62.2	0.700	−27.2
8	0.775	−67.7	2.482	115.3	0.089	55.9	0.671	−32.6
10	0.717	−78.3	2.154	105.0	0.096	52.8	0.657	−37.2
12	0.667	−87.2	1.897	94.4	0.103	52.6	0.644	−41.4
14	0.631	−93.7	1.666	85.4	0.103	55.0	0.648	−45.1
16	0.625	−99.4	1.542	75.4	0.105	58.8	0.627	−47.8
18	0.605	−106.8	1.237	63.6	0.123	62.6	0.645	−46.7

S11

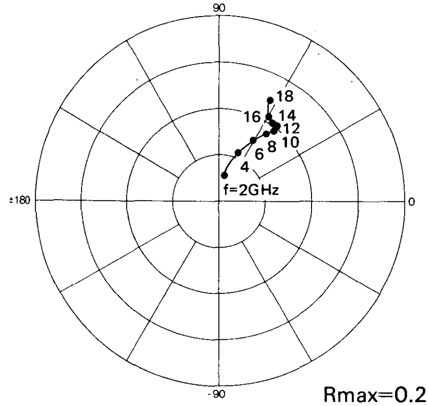


S21



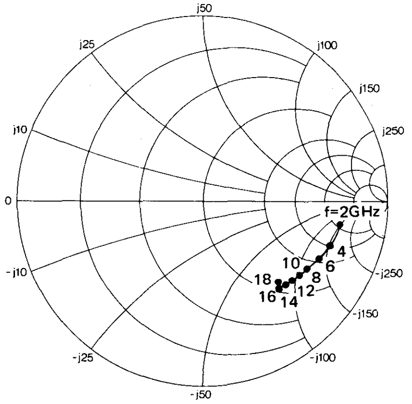
Rmax=5

S12

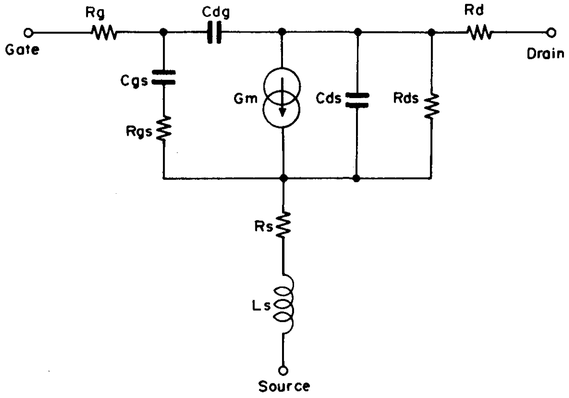


Rmax=0.2

S22



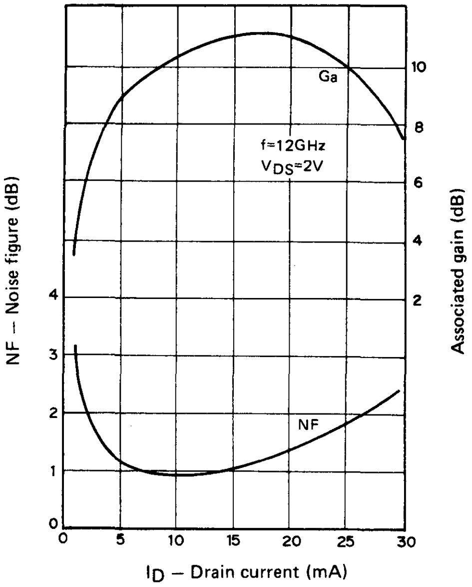
Equivalent Circuit



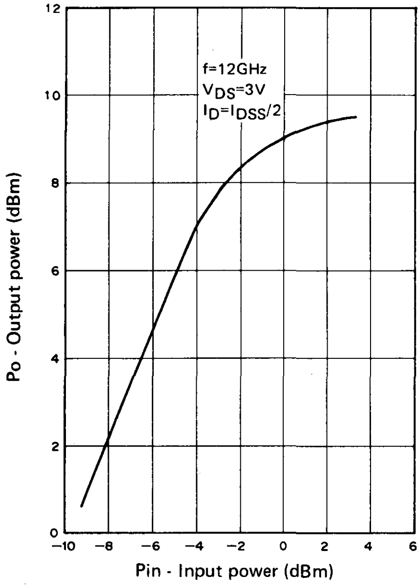
V_{DS}=2V, I_D=10 mA

Parameter	Value
Rg	1Ω
Cgs	0.23 pF
Rgs	3.5Ω
Gm	50 mS
Cds	0.06 pF
Rds	300Ω
Rd	1Ω
Rs	3.5Ω
Ls	0.08 nH
Cdg	28 fF

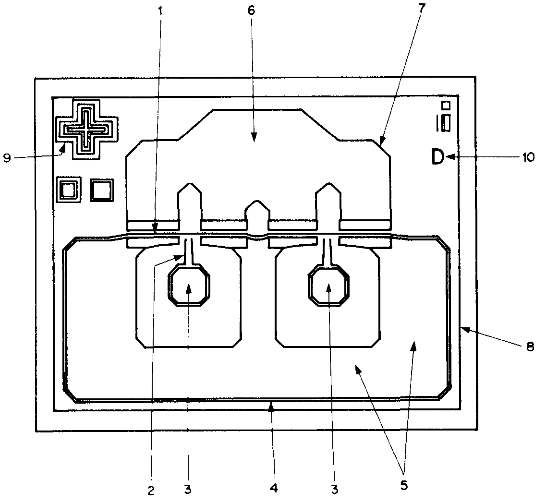
Minimum noise figure vs. Drain current



Output power at 1 dB gain compression

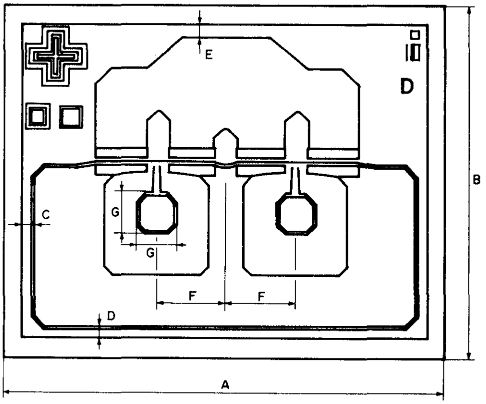


Chip Outline



1. Gate area
2. Gate metal
3. Gate bonding pad
4. Source metal
5. Source bonding pad
6. Drain bonding pad
7. Drain metal
8. Scribe line
9. Alignment mark
10. D: 2SK676H5

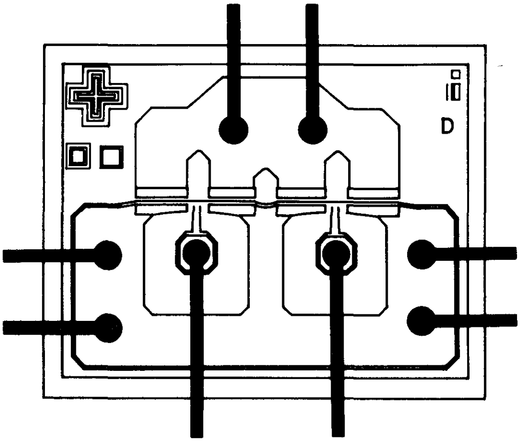
Chip Pattern Dimension



Symbol	Dimension (μm)
A	500 ±50
B	400 ±50
C	15 ± 3
D	10 ± 3
E	15 ± 3
F	75 ± 5
G	44 ± 5

Chip thickness	200±30μm
Pad metal	Ti/Au 0.45±0.05μm
Back metal	Ti/Au 0.45±0.05μm

Recommended Bonding Position



HEMT Chip Handling Precautions

1) All handling and assembly operations should be done in a clean and dry environment.

2) Chips should be stored in a dry nitnogen environment at room temperature.

3) Care must be exercised when handling GaAs chips, since they break easily under pressure.

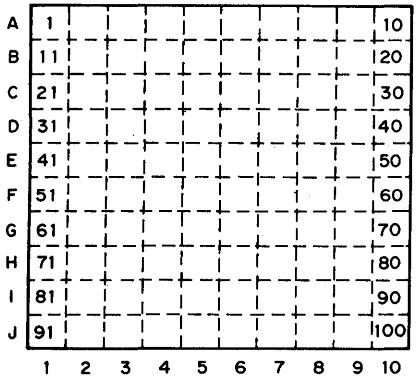
4) All equipment used for handling, die attachment, and wire bonding must be properly grounded to avoid electrostatic damage to the chips.

5) Die attachment: Use AuSn alloy in nitrogen atmosphere. The temperature should be 280 to 300°C, and the operation time should be kept as short as possible. When using Ag paste, cure for one hour at 160°C in a nitrogen atmosphere.

6) Wire bonding: Thermal compression wedge bonding is recommended.
The temperature should be under 290°C, and the operation time should be kept under a minute. Bonding wire diameter should be 0.7 to 1.0 mils (18 to 25 microns) diameter gold. Wire lengths should, in general, be kept as short as possible.

Packaging

The chip is placed on the film carrier and numbered as shown in the figure, starting in the top left corner.



SONY® **2SK677H5**

AlGaAs/GaAs Low Noise Microwave HEMT CHIP **Preliminary**

Description

The 2SK677H5 is an AlGaAs/GaAs HEMT chip fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception and other communications systems up to K-band.

Features

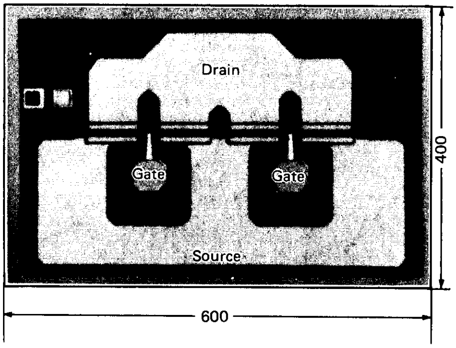
- Low noise figure
- Excellent device uniformity
- High gain
- Wide band

Structure

AlGaAs/GaAs N-channel HEMT chip
Twin gate-pad π geometry

Chip outline

Unit: μm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	100	mA

Electrical Characteristics

Ta=25°C

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−150	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		15	60	100	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	Y_{fs}	V_{DS}=2V, I_D=15mA		37	60		ms
Noise figure	NF	V_{DS}=2V, I_D=15mA	f=12GHz			1.4	dB
Associated gain at NF min.	Ga	V_{DS}=2V I_D=15mA	f=12GHz	9	11		dB

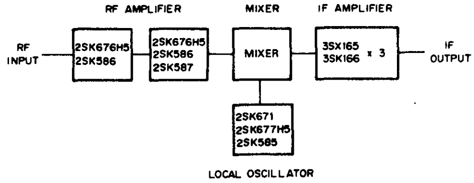
Noise figure ranks determined on a sampling basis by measuring ceramic-mounted devices.

Noise Figure Classification (f=12 GHz)

	Min.	Typ.	Max.	
2SK677H5-1	–	–	1.0	dB
2SK677H5-2	–	–	1.2	
2SK677H5-3	–	–	1.4	

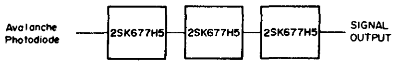
V_{DS}=2V
I_D=15mA

X-Band, and K-Band Downconverter Block Diagram

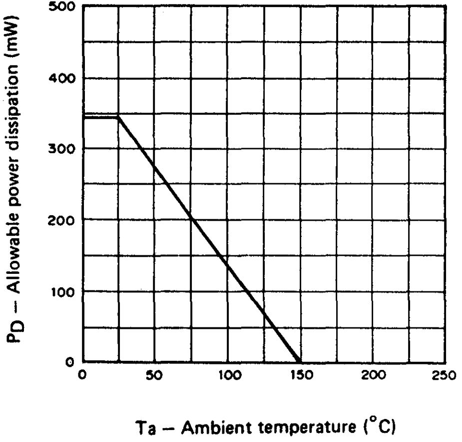


Wideband Microwave Amplifier (1-5 GHz)

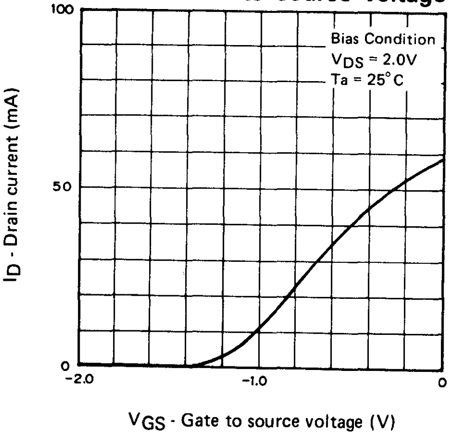
(preamplifier for optical detector system)



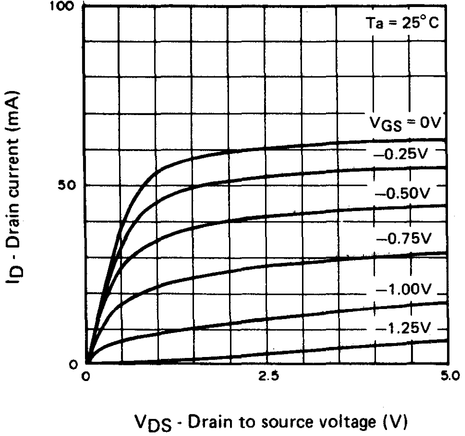
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

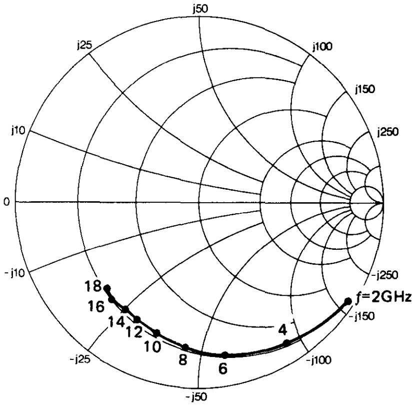


S-Parameter vs. Frequency Characteristics

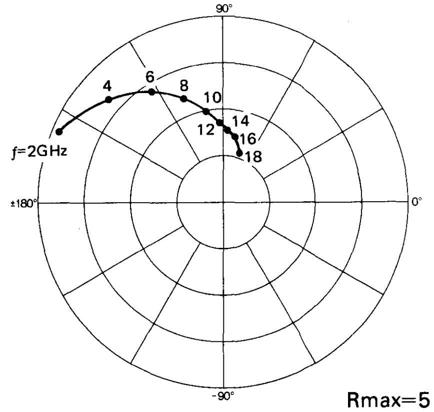
V_{DS}=2V, I_D=15 mA

f (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2	0.972	−33.1	4.808	157.4	0.037	72.5	0.675	−15.6
4	0.888	−58.3	4.133	137.5	0.065	59.2	0.642	−28.8
6	0.838	−80.2	3.535	122.5	0.086	48.2	0.606	−40.5
8	0.781	−95.1	2.948	111.1	0.098	41.4	0.581	−48.3
10	0.741	−107.6	2.487	101.4	0.106	35.2	0.568	−54.9
12	0.711	−118.4	2.132	93.1	0.110	29.3	0.557	−59.5
14	0.701	−124.5	1.884	86.8	0.109	28.9	0.586	−63.5
16	0.724	−133.2	1.796	80.2	0.125	22.4	0.587	−76.0
18	0.682	−137.2	1.403	74.0	0.105	10.4	0.496	−73.4

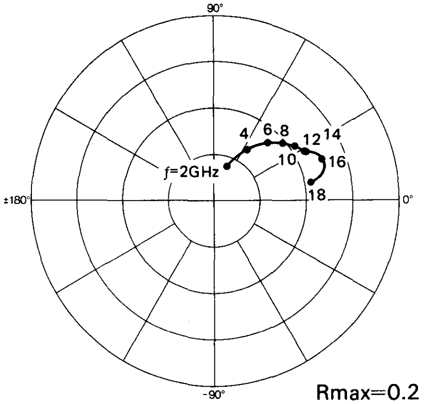
S11



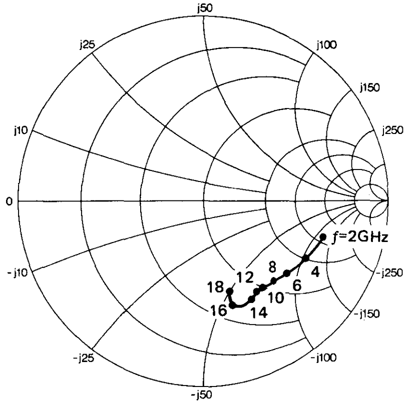
S21



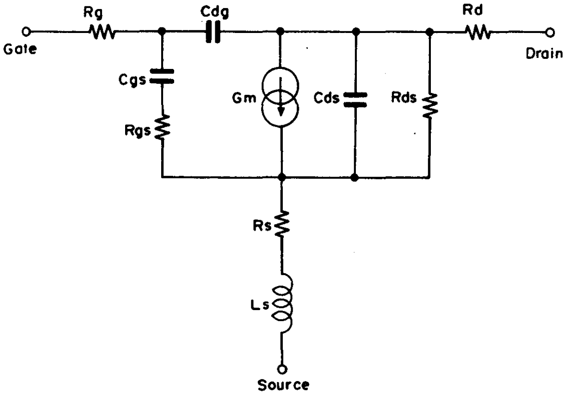
S12



S22



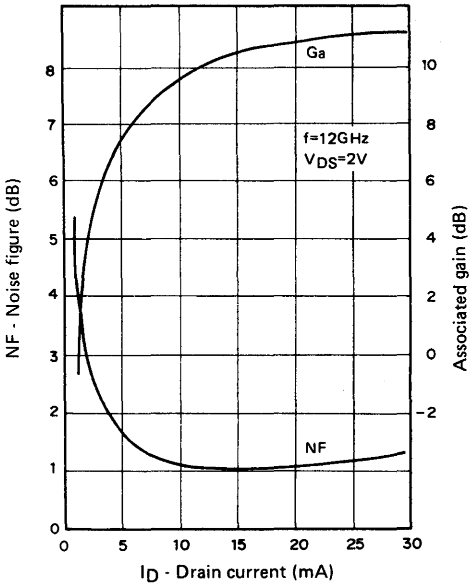
Equivalent Circuit



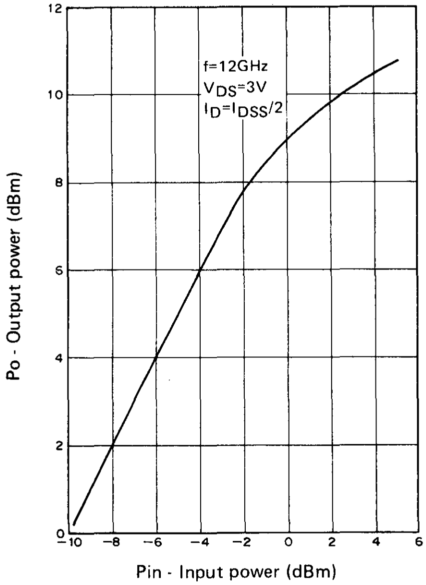
V_{DS}=2V, I_D=15 mA

Parameter	Value
Rg	1.5Ω
Cgs	0.36 pF
Rgs	3Ω
Gm	64 mS
Cds	0.08 pF
Rds	200Ω
Rd	1Ω
Rs	2.3Ω
Ls	0.01 nH
Cdg	40 fF

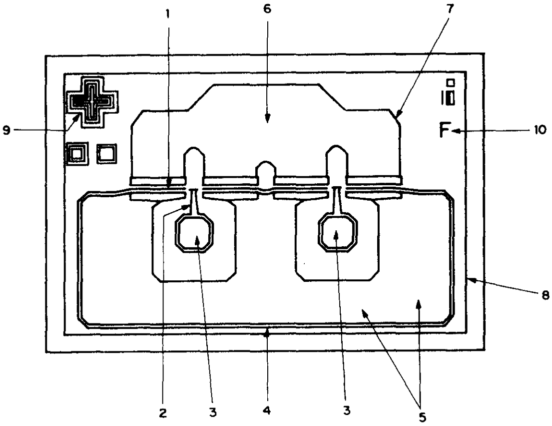
Minimum noise figure vs. Drain current



Output Power at 1 dB gain compression

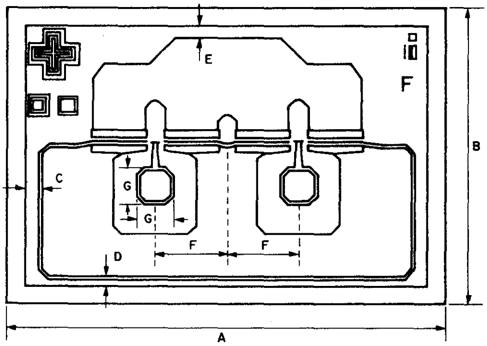


Chip Outline



1. Gate Area
2. Gate Metal
3. Gate Bonding Pad
4. Source Metal
5. Source Bonding Pad
6. Drain Bonding Pad
7. Drain Metal
8. Scribe Line
9. Alignment Mark
10. F : 2SK677H5

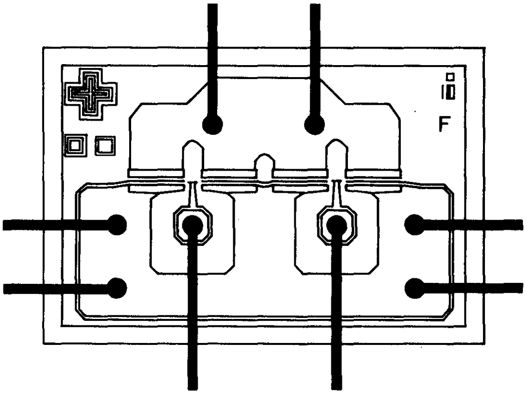
Chip Pattern Dimension



Symbol	Dimension (μm)
A	600 ±50
B	400 ±50
C	15 ± 3
D	10 ± 3
E	15 ± 3
F	100 ± 5
G	44 ± 5

Chip thickness	200±30μm
Pad metal	Ti/Au 0.45±0.05μm
Back metal	Ti/Au 0.45±0.05μm

Recommended Bonding Position



HEMT Chip Handling Precautions

1) All handling and assembly operations should be done in a clean and dry environment.

2) Chips should be stored in a dry nitnogen environment at room temperature.

3) Care must be exercised when handling GaAs chips, since they break easily under pressure.

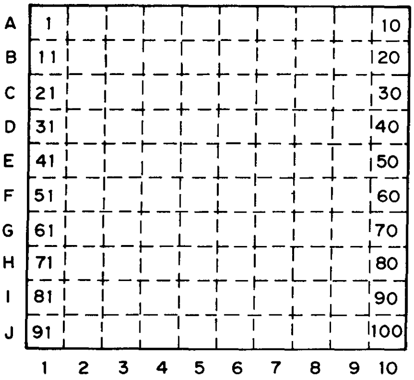
4) All equipment used for handling, die attachment, and wire bonding must be properly grounded to avoid electrostatic damage to the chips.

5) Die attachment: Use AuSn alloy in nitrogen atmosphere. The temperature should be 280 to 300°C, and the operation time should be kept as short as possible. When using Ag paste, cure for one hour at 160°C in a nitrogen atmosphere.

6) Wire bonding: Thermal compression wedge bonding is recommended.
The temperature should be under 290°C, and the operation time should be kept under a minute. Bonding wire diameter should be 0.7 to 1.0 mils (18 to 25 microns) diameter gold. Wire lengths should, in general, be kept as short as possible.

Packaging

The chip is placed on the film carrier and numbered as shown in the figure, starting in the top left corner.



SONY 2SK877

AlGaAs/GaAs Low Noise Microwave HEMT

Description

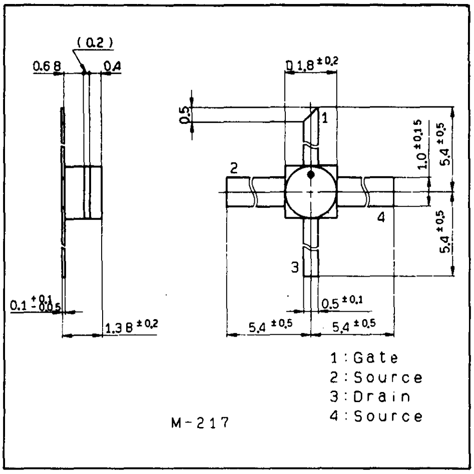
The **2SK877** is an AlGaAs/GaAs HEMT fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception (DBS, FSS, TVRO) and other communications systems.

Structure

AlGaAs/GaAs N-Channel HEMT

Package Outline

Unit: mm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	70	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	−55 to +150	°C
• Allowable power dissipation	P_D	340	mW

Electrical Characteristics

Ta=25°C

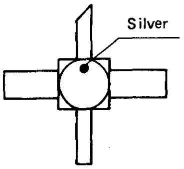
Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−100	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		10	40	70	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	V_{DS}=2V, I_D=10mA		25	60		mS
Noise figure	NF	V_{DS}=2V, I_D=10mA	f=12GHz			1.5	dB
Associated gain at NF Min.	Ga	V_{DS}=2V I_D=10mA	f=12GHz	8.5	10.5		dB

Classification

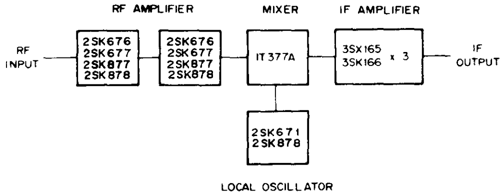
f=12 GHz

Rank	Min.	Typ.	Max.	Unit
2SK877-1	—	—	1.3	dB
2SK877-2	—	—	1.5	
2SK877-3	—	—	1.8	

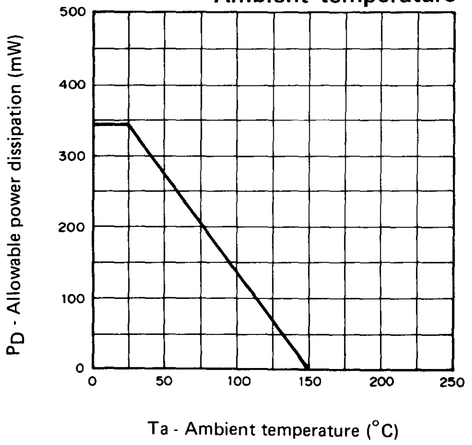
Mark



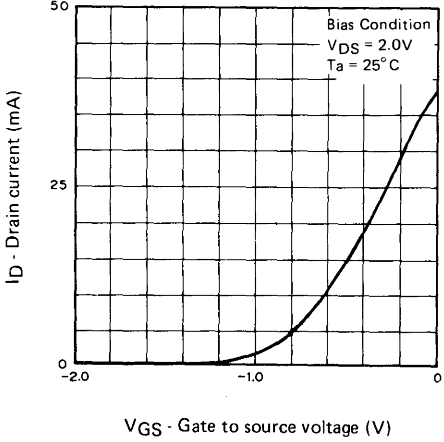
C-Band, X-Band, and K-Band Downconverter Block Diagram



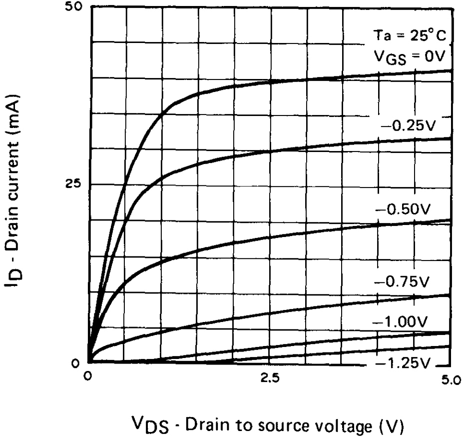
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

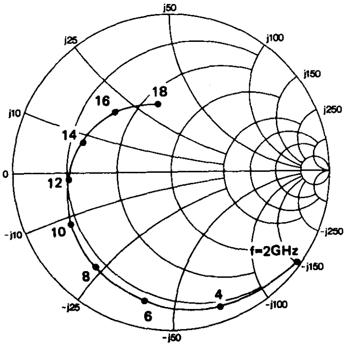


S-Parameter vs. Frequency Characteristics

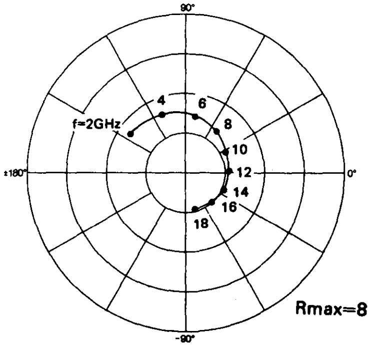
VDS=2V, ID=10 mA

f	S11		S21		S12		S22	
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.0	.971	−36.4	3.420	144.9	.028	63.3	.737	−25.1
3.0	.940	−53.9	3.310	128.2	.039	53.0	.719	−37.2
4.0	.902	−70.8	3.167	111.8	.048	41.2	.698	−49.5
5.0	.866	−86.7	3.015	96.2	.052	31.4	.680	−61.6
6.0	.826	−101.8	2.854	81.1	.056	23.3	.659	−73.6
7.0	.794	−115.9	2.699	67.0	.058	15.2	.648	−85.5
8.0	.766	−128.7	2.557	53.5	.058	9.9	.643	−97.3
9.0	.741	−140.6	2.438	40.6	.058	3.6	.642	−108.1
10.0	.713	−152.6	2.339	27.5	0.57	.2	.643	−119.2
11.0	.682	−164.2	2.237	14.9	.057	−2.0	.649	−129.8
12.0	.653	−175.9	2.160	2.5	.059	−3.0	.652	−140.9
13.0	.626	172.4	2.088	−10.1	.060	−6.9	.660	−152.4
14.0	.591	160.6	2.051	−22.5	.064	−12.1	.677	−162.2
15.0	.555	147.6	2.001	−35.2	.070	−14.1	.691	−172.3
16.0	.515	133.4	1.970	−48.3	.076	−21.1	.708	178.3
17.0	.475	117.9	1.939	−61.6	.081	−31.3	.722	168.0
18.0	.432	100.2	1.918	−75.4	.088	−42.7	.730	157.1

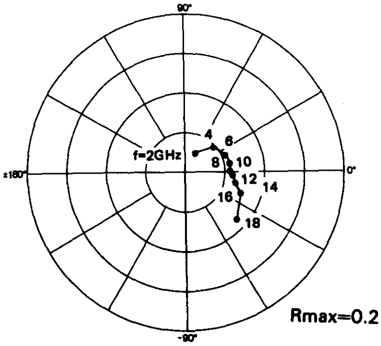
S11



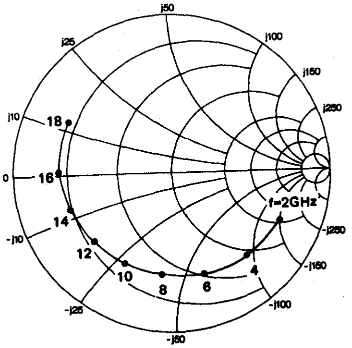
S21



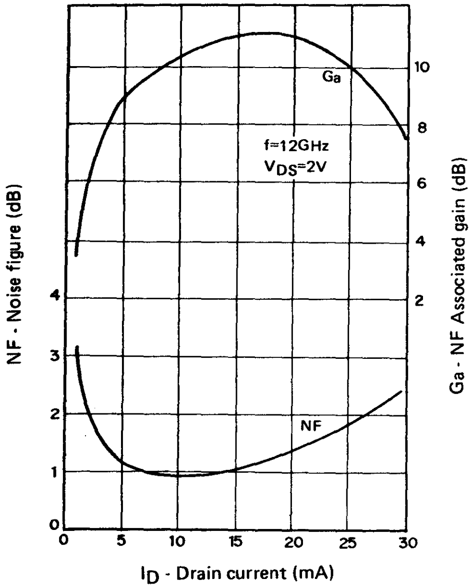
S12



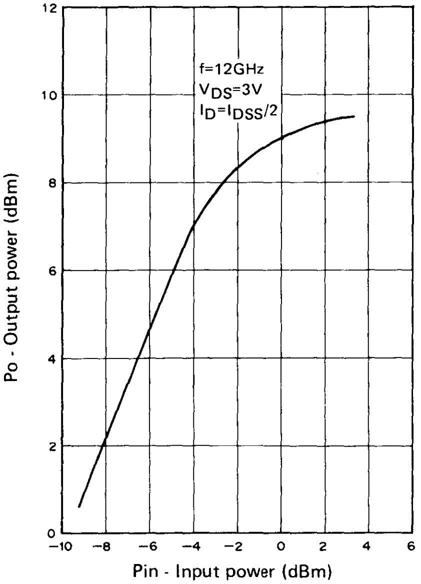
S22



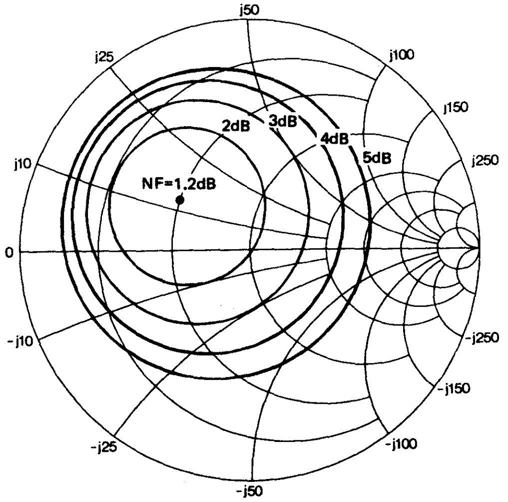
Minimum noise figure vs. Drain current



Output power at 1 dB gain compression



Noise Figure Characteristics



NFmin=1.2dB
at Gamma=0.380
Angle=145.0

f=12GHz
V_{DS}=2V
I_D=10mA

NF, Ga, Gamma Optimum Characteristics (V_{DS}=2V, I_D=10 mA)

Frequency (GHz)	NF (dB)	Ga (dB)	Gamma Optimum	
			MAG	ANG
12	1.2	11.1	0.380	145.0

SONY

2SK878

AlGaAs/GaAs Low Noise Microwave HEMT

Description

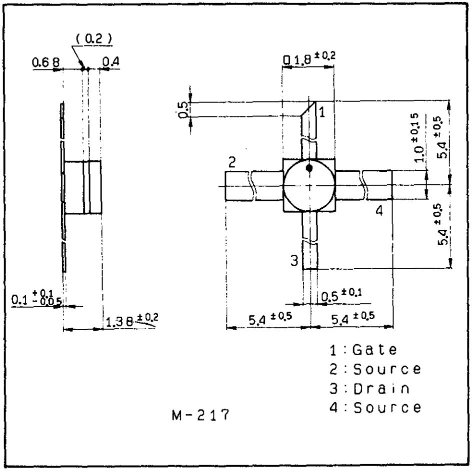
The 2SK878 is an AlGaAs/GaAs HEMT fabricated by MOCVD (Metal Organic Chemical Vapor Deposition). This 0.5 micron gate FET features very low noise figure and high gain, and is suitable for a wide range of front-end amplifier applications including satellite reception (DBS, FSS, TVRO) and other communications systems.

Structure

AlGaAs/GaAs N-Channel HEMT

Package Outline

Unit: mm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DS}	5	V
• Gate to source voltage	V_{GSO}	−3.5	V
• Drain current	I_D	100	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	−55 to +150	°C
• Allowable power dissipation	P_D	340	mW

Electrical Characteristics

(Ta=25°C)

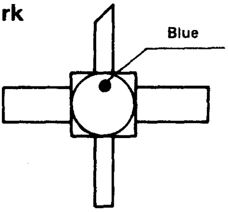
Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Gate to source cutoff current	I_{GSS}	V_{DS}=0V, V_{GS}=−3V				−150	μA
Drain current	I_{DSS}	V_{DS}=2V, V_{GS}=0V		15	60	100	mA
Gate to source cutoff voltage	$V_{GS(OFF)}$	V_{DS}=2V, I_D=500μA		−0.2	−1.5	−3.0	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	V_{DS}=2V, I_D=15mA		37	60		mS
Noise figure	NF	V_{DS}=2V, I_D=15mA	f=12GHz*			1.5	dB
Associated gain at NF min.	Ga	V_{DS}=2V I_D=15mA	f=12GHz	8.5	10.5		dB

* Classification (f=12 GHz)

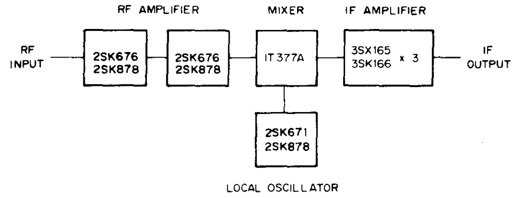
Rank	Min.	Typ.	Max.	Unit
2SK878-1	–	–	1.3	dB
2SK878-2	–	–	1.5	

V_{DS}=2V
I_D=15mA

Mark

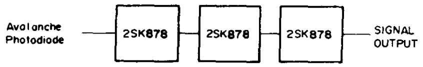


X-Band, and K-Band Downconverter Block Diagram

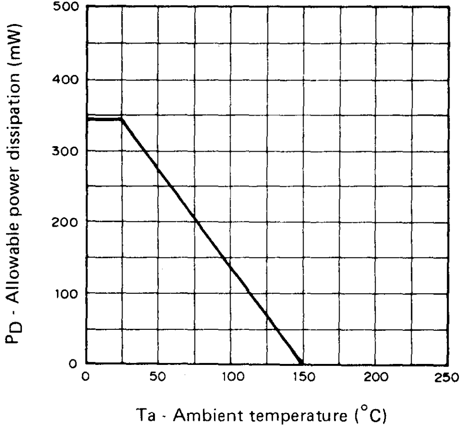


Wideband Microwave Amplifier (1-5 GHz)

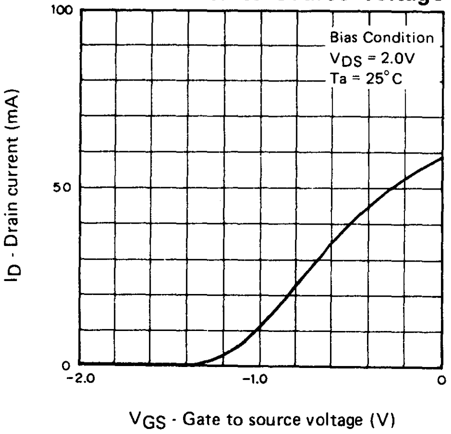
(preamplifier for optical detector system)



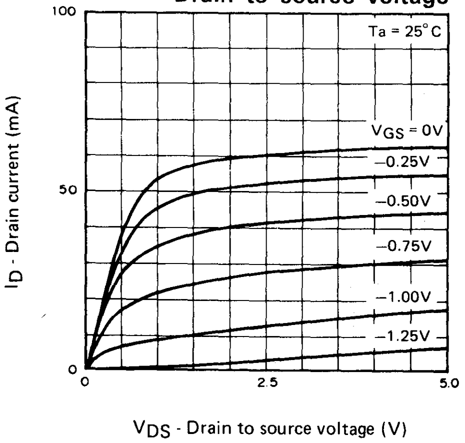
Allowable power dissipation vs. Ambient temperature



Drain current vs. Gate to source voltage



Drain current vs. Drain to source voltage

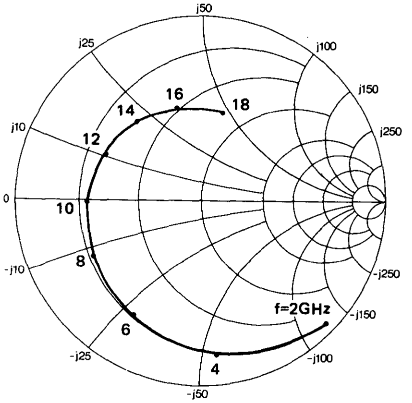


S-Parameter vs. Frequency Characteristics

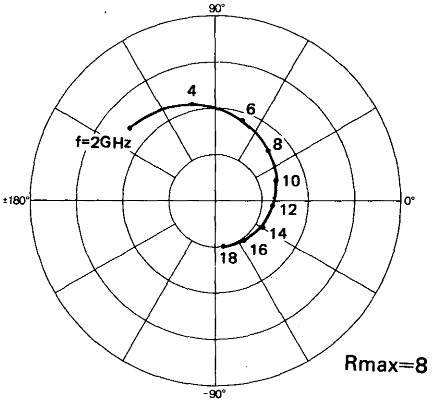
(V_{DS}=2V, I_D=15 mA)

f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.0	.946	−44	4.881	140	.033	62	.646	−29
3.0	.890	−64	4.607	121	.046	50	.620	−43
4.0	.834	−84	4.294	104	.054	37	.593	−55
5.0	.775	−103	3.959	87	.059	29	.570	−67
6.0	.729	−120	3.629	72	.063	23	.552	−79
7.0	.689	−137	3.333	57	.065	16	.538	−91
8.0	.657	−152	3.081	44	.066	10	.536	−101
9.0	.633	−166	2.875	31	.067	7	.537	−112
10.0	.614	−179	2.707	19	.071	5	.538	−121
11.0	.595	168	2.553	6	.073	2	.545	−130
12.0	.577	155	2.416	−5	.079	0	.545	−140
13.0	.569	143	2.345	−16	.083	−5	.551	−151
14.0	.553	130	2.334	−30	.090	−12	.549	−160
15.0	.525	118	2.161	−43	.099	−17	.573	−169
16.0	.514	106	2.095	−54	.104	−24	.591	−178
17.0	.505	92	2.065	−67	.112	−33	.590	172
18.0	.483	78	2.018	−80	.120	−42	.579	161

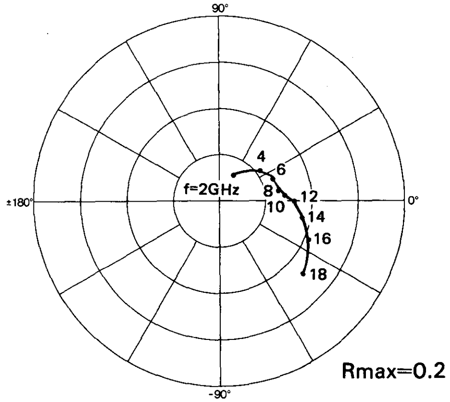
S_{11}



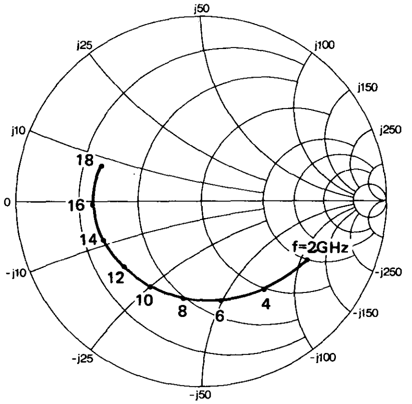
S_{21}



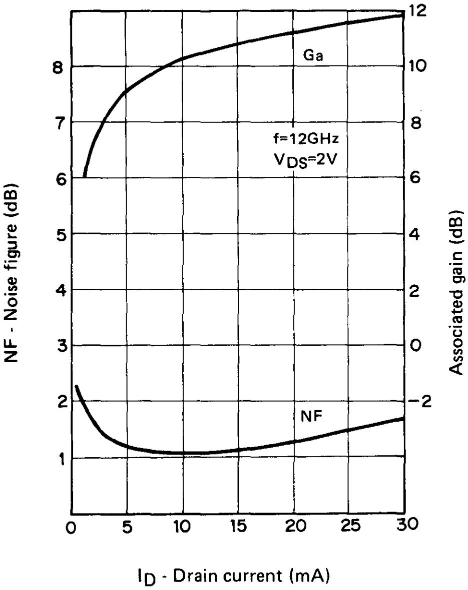
S_{12}



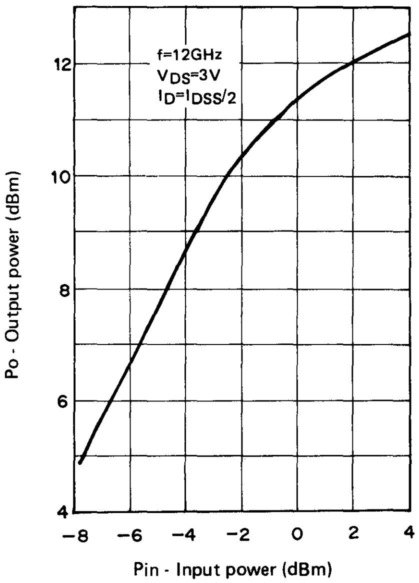
S_{22}



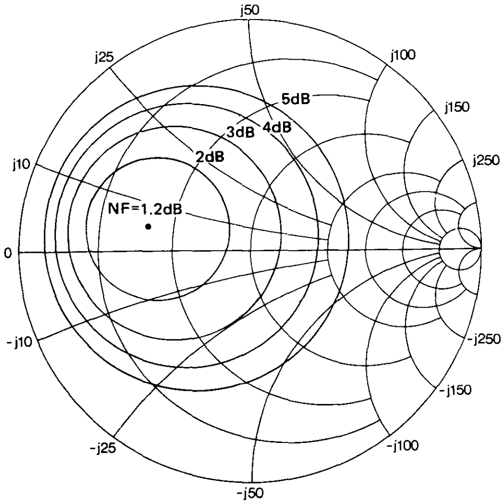
Minimum noise figure vs. Drain current



Output Power at 1 dB gain compression



Noise figure characteristics



NFmin=1.2dB
at Gamma=0.461
Angle=166.5

f=12GHz
V_{DS}=2V
I_D=15mA

NF, Ga, Gamma Optimum Characteristics (V_{DS}=2V, I_D=15 mA)

Frequency (GHz)	NF (dB)	Ga (dB)	Gamma Optimum	
			Magnitude	Angle
12	1.2	11.1	0.461	166.5

SONY

3SK164/-M

GaAs N-Channel Dual-Gate MES FET

Description

The 3SK164/-M is a GaAs N-channel Dual-Gate MES FET for low noise UHF amplifiers and mixers. Low noise, high gain characteristics and low operating voltage are accomplished by optimum mask pattern design. Simplified high frequency circuits adjustments are made possible by the miniaturized plastic molded package which contributes to reduce parasitic elements of the device.

Features

- Low operating voltage
- Low NF NF = 1.2 dB (Typ.) at 800MHz
- High PG PG = 22 dB (Typ.) at 800MHz
- High stability
- Protection diode included

Structure

GaAs N-Channel Dual-Gate MES (Metal Semiconductor) type FET.

Applications

- UHF T.V. Tuner, amplifier, mixer, oscillator.

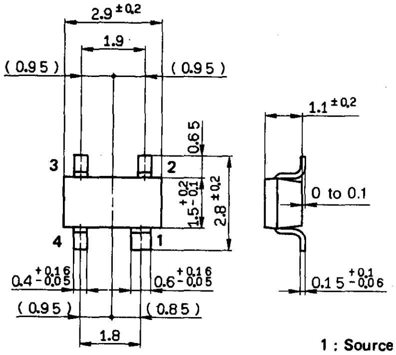
Absolute Maximum Ratings (Ta = 25°C)

• Drain to source voltage	V_{DSX}	12	V
• Gate 1 to source voltage	V_{G1S}	-5	V
• Gate 2 to source voltage	V_{G2S}	-5	V
• Drain current	I_D	55	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	– 55 to + 150	°C
• Allowable power dissipation	P_D	150	mW

Package Outline

Unit: mm

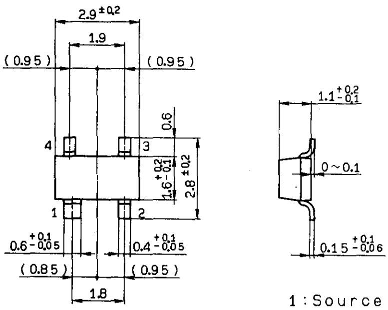
3SK164



M-206

1 : Source
2 : Gate 1
3 : Gate 2
4 : Drain

3SK164-M



1 : Source
2 : Drain
3 : Gate 2
4 : Gate 1

M-234

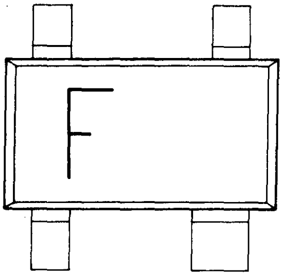
Electrical Characteristics

Ta = 25°C

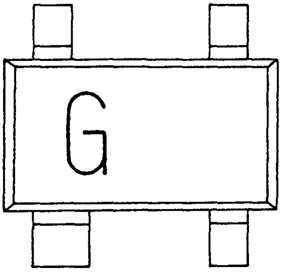
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain to source voltage	V_{DSX}	I_D =100μA V_{G1S} = 0V V_{G2S} = −4.0V	11			V
Gate 1 cutoff current	I_{G1SS}	V_{G1S} = −4.5V V_{G2S} = 0V V_{DS} = 0V			−10	μA
Gate 2 cutoff current	I_{G2SS}	V_{G2S} = −4.5V V_{G1S} = 0V V_{DS} = 0V			−10	μA
Gate 2 to drain cutoff current	I_{G2DO}	V_{G2D} = −12V			−10	μA
Drain saturation current	I_{DSS}	V_{DS} = 5V V_{G1S} = 0V V_{G2S} = 0V	10		35	mA
Gate 1 cutoff voltage	V_{G1S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G2S} = 0V			-2.5	V
Gate 2 cutoff voltage	V_{G2S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G1S} = 0V			-2.5	V
Forward transfer admittance	$\|Y_{fs}\|$	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1KHz	18	26		mS
Input capacitance	Ciss	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1MHz		1.1	3	pF
Reverse transfer capacitance	Crss			28	40	fF
Power gain	PG	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 800MHz	17	22		dB
Noise figure	NF			1.2	2.5	dB

Mark

3SK164

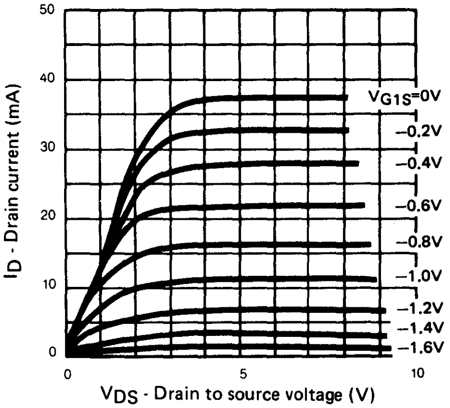


3SK164-M



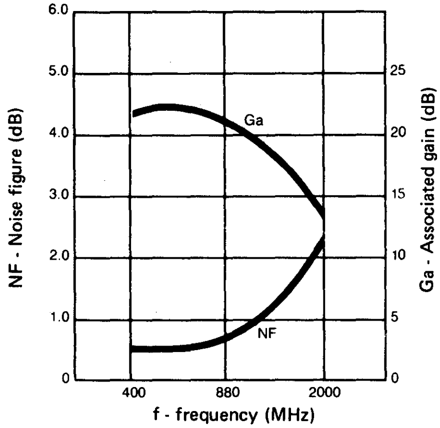
Output characteristics

(Ta=25°C, V_{G2S}=1.5V, V_{G1S}=−0.2Vstep)



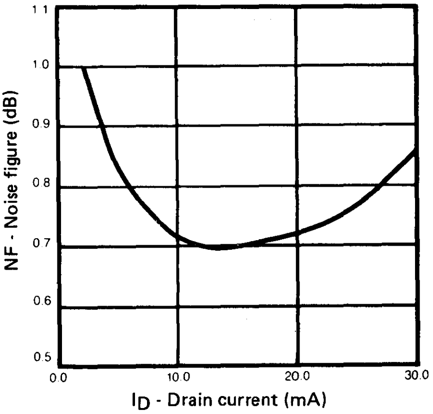
NF, Ga frequency dependence

(V_{DS}=5V, V_{G2S}=1.5V, I_D=10mA)

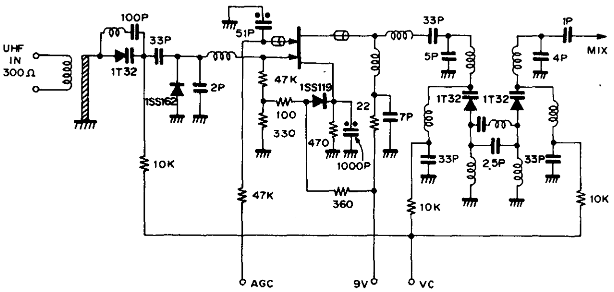


NF-I_D characteristics

(V_{DS}=5.0V, V_{G2S}=1.5V, Frequency at 450MHz)

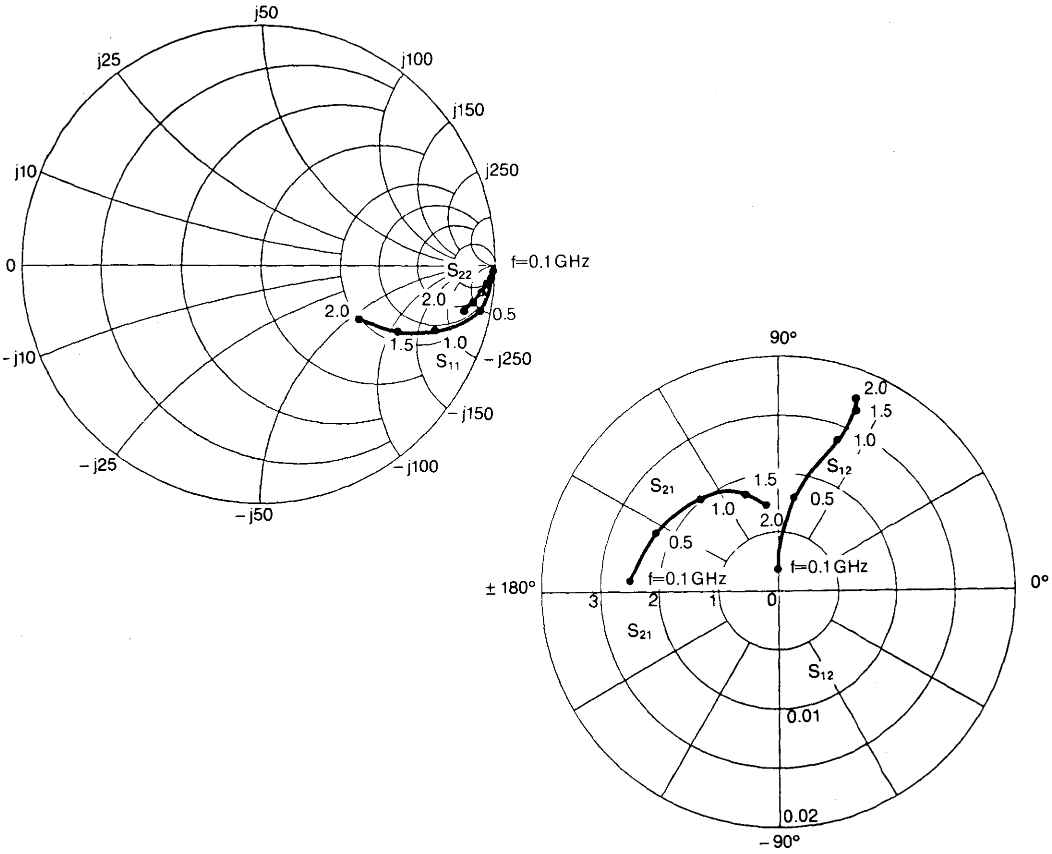


RF Circuit (UHF tuner)



S-Parameters vs. Frequency Characteristics

(V_{DS}=5.0V, V_{G2S}=1.5V, I_D=10mA)



S-Parameter Data of FET 3SK164/-M

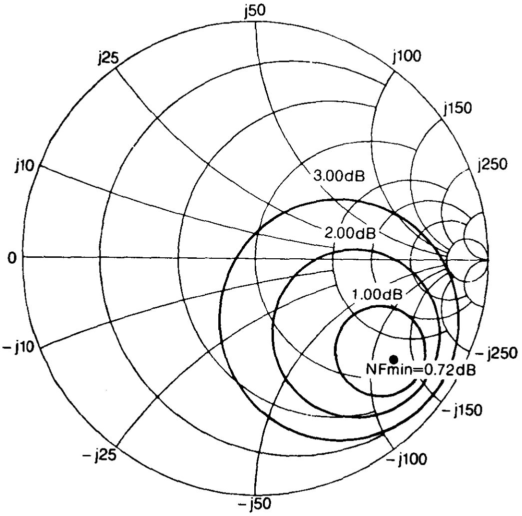
Z_o=50Ω

Frequency MHz	S_{11}		S_{21}		S_{12}		S_{22}	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	.996	-4.29	2.463	174.58	0.0017	90.33	.969	-1.24
200	.991	-8.41	2.429	167.53	0.0032	82.30	.970	-2.71
300	.992	-12.08	2.423	161.43	0.0042	85.75	.981	-5.05
400	.967	-16.21	2.415	160.18	0.0072	85.39	.962	-5.36
500	.944	-19.67	2.288	154.96	0.0080	79.42	.961	-6.27
600	.920	-23.29	2.275	147.32	0.0097	77.89	.964	-7.75
700	.892	-26.72	2.233	144.80	0.0111	74.26	.954	-8.54
800	.865	-29.98	2.128	140.64	0.0117	75.69	.952	-10.22
900	.836	-32.83	2.018	133.59	0.0125	71.74	.940	-10.92
1000	.807	-35.39	2.079	128.17	0.0139	68.31	.940	-12.55
1200	.736	-40.18	1.874	123.16	0.0162	69.28	.932	-15.15
1400	.672	-44.73	1.845	114.38	0.0174	64.55	.919	-17.33
1600	.615	-48.21	1.676	108.69	0.0173	68.24	.915	-18.83
1800	.547	-50.41	1.655	102.68	0.0179	66.81	.908	-19.93
2000	.471	-53.14	1.435	95.70	0.0178	68.29	.892	-21.04

Noise Figure Characteristics

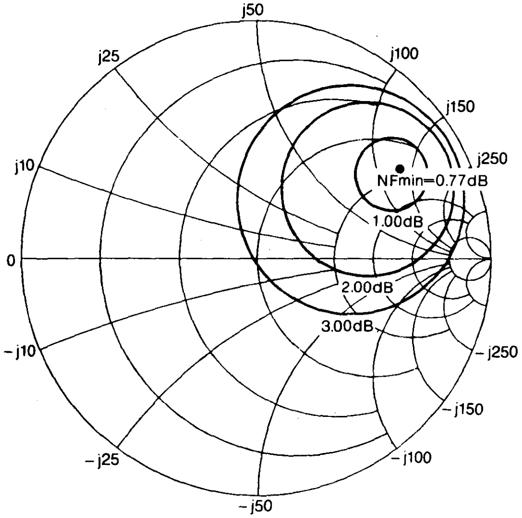
(VDS=5.0V, VG2S=1.5V, IDS=10mA)

at 450MHz



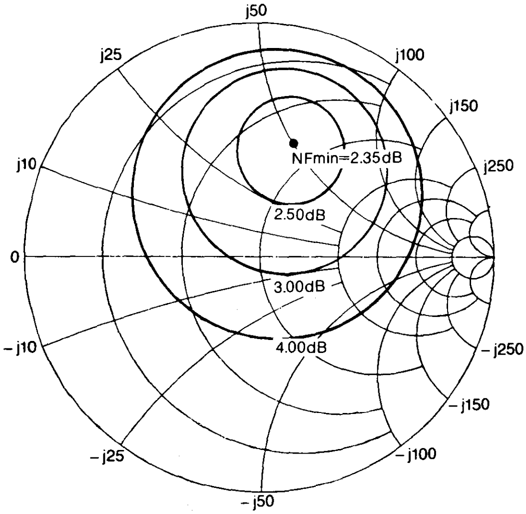
VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 450 MHz
NF min 0.72 dB
Ga 20.57 dB
Gamma (S); MAG 0.730 ANG −35.46°
Gamma (L); MAG 0.833 ANG −46.85°

at 880MHz



VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 880 MHz
NF min 0.77 dB
Ga 20.57 dB
Gamma (S); MAG 0.725 ANG 32.68°

at 2000MHz



Frequency (MHz)	Ga (dB)	NF (dB)	Gamma- S		Gamma- L	
			MAG	ANG	MAG	ANG
400	21.69	0.60	0.747	−78.04°	0.912	−76.72°
450	20.57	0.72	0.730	−35.46°	0.833	−46.85°
500	22.03	0.71	0.813	4.63°	0.560	−5.95°
880	20.75	0.77	0.725	32.68°		
2000	13.38	2.35	0.510	73.32°		

VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 2000 MHz
NF min 2.35 dB
Ga 13.38 dB
Gamma (S); MAG 0.510 ANG 73.32°

3SK165

GaAs N-Channel Dual-Gate MES FET

Description

The 3SK165 is a GaAs N-channel Dual-Gate MES FET for low noise UHF amplifiers and mixers. Low noise and high gain characteristics are accomplished by optimum mask pattern design. Easier high frequency circuits adjustments are made possible by the miniaturized plastic molded package which contributes to reduce parasitic elements of the device.

Features

• Low NF	NF = 1.2 dB (Typ.) at 800MHz
• High PG	PG = 20 dB (Typ.) at 800MHz
• High stability	

Applications

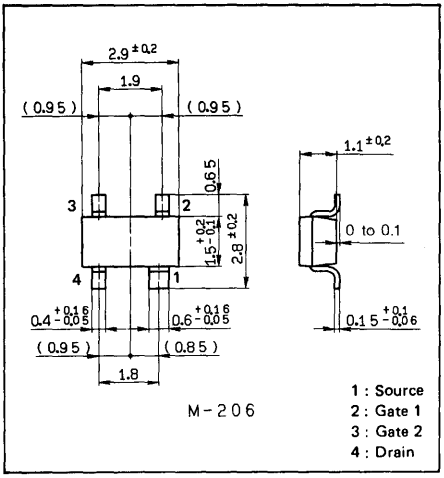
- UHF Amplifier, mixer, oscillator

Absolute Maximum Ratings (Ta = 25°C)

• Drain to source voltage	V_{DSX}	8	V
• Gate 1 to source voltage	V_{G1S}	−6	V
• Gate 2 to source voltage	V_{G2S}	−6	V
• Drain current	I_D	80	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	− 55 to + 150	°C
• Allowable power dissipation	P_D	150	mW

Package Outline

Unit: mm



Electrical Characteristics

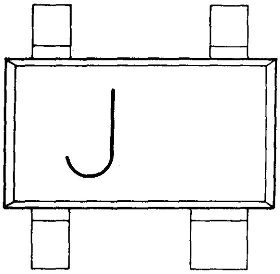
Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain to source voltage	V_{DSX}	I_D = 200μA V_{G1S} = 0V V_{G2S} = −5V	8			V
Gate 1 cutoff current	I_{G1SS}	V_{G1S} = −4V V_{G2S} = 0V V_{DS} = 0V			−20	μA
Gate 2 cutoff current	I_{G2SS}	V_{G2S} = −4V V_{G1S} = 0V V_{DS} = 0V			−20	μA
Drain saturation current*	I_{DSS}*	V_{DS} = 5V V_{G1S} = 0V V_{G2S} = 0V	20		55	mA
Gate 1 cutoff voltage	V_{G1S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G2S} = 0V	-1		-4	V
Gate 2 cutoff voltage	V_{G2S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G1S} = 0V	-1		-4	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1KHz	15	22		mS
Input capacitance	Ciss	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1MHz		0.5	1.0	pF
Reverse transfer capacitance	Crss			7.5	25	fF
Power gain	PG	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 800MHz	16	20		dB
Noise figure	NF			1.2	2.5	dB

* Classification

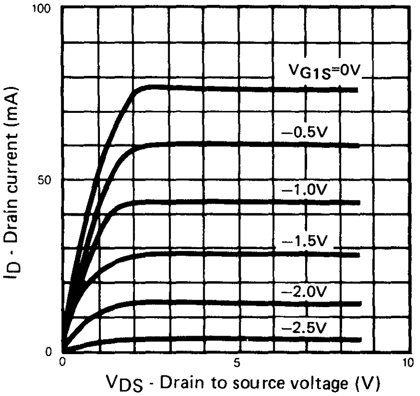
Rank	I_{DSS}	Unit
3SK165-0	20−55	mA
3SK165-1	20−35	mA
3SK165-2	30−55	mA

Mark



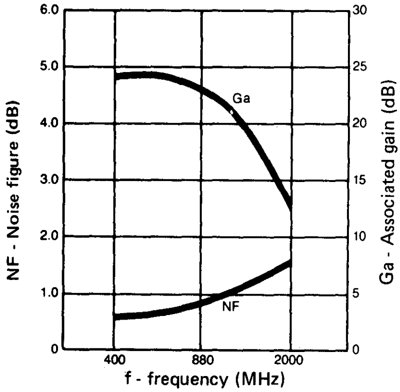
Output characteristics

(Ta=25°C, V_{G2S}=1.5V, V_{G1S}=−0.5V/step)



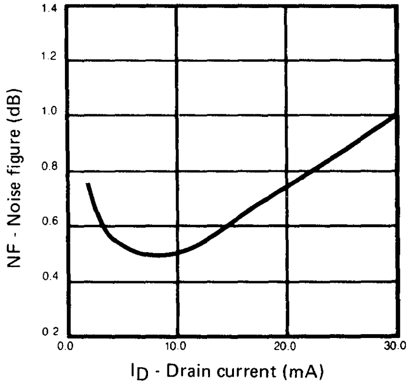
NF, Ga frequency dependence

(V_{DS}=5.0V, V_{G2S}=1.5V, I_D=10mA)

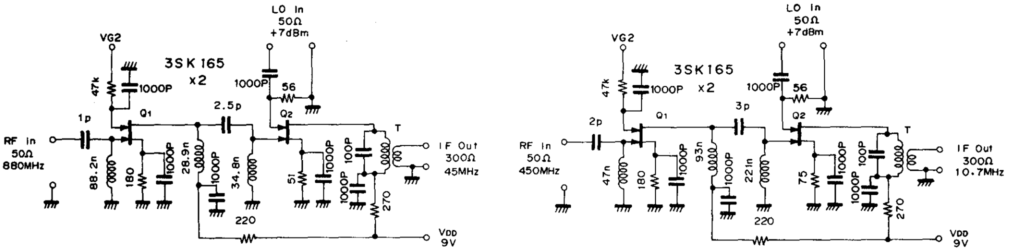


NF-I_D characteristics

(V_{DS}=5.0V, V_{G2S}=1.5V, Frequency at 450MHz)

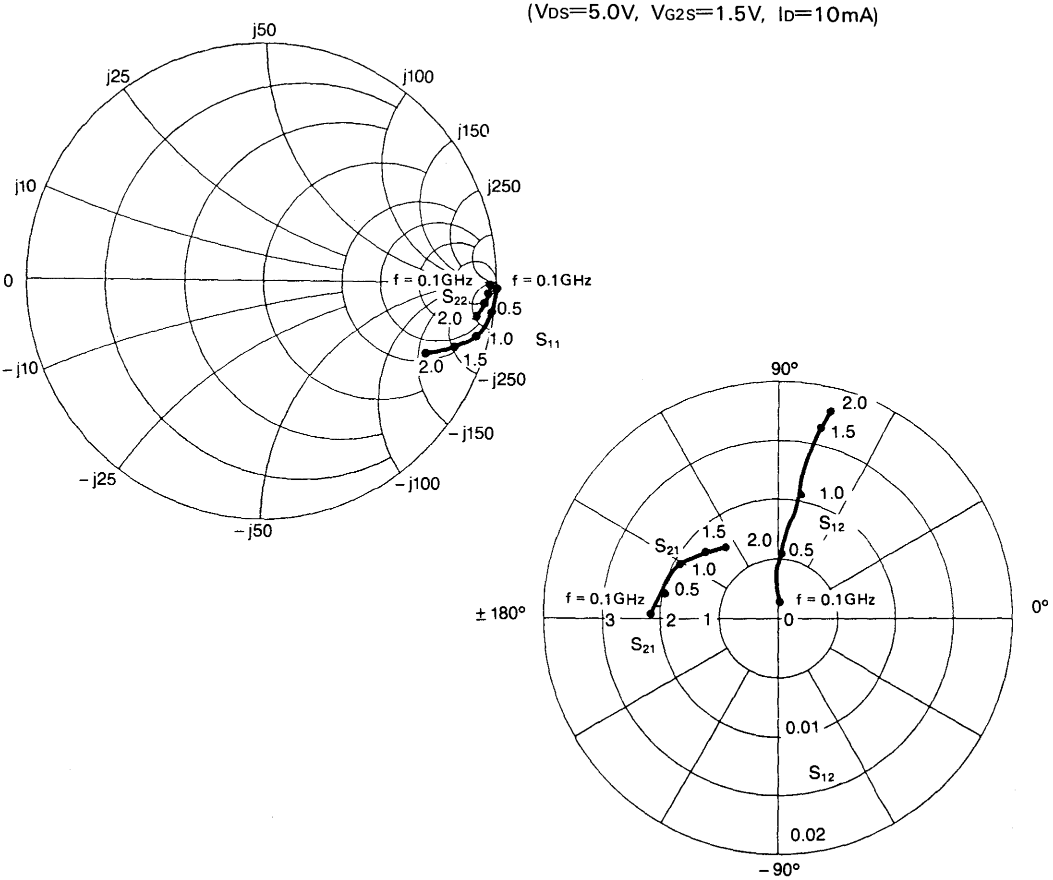


Application Circuit (Front-end amplifier)



S-Parameters vs. Frequency characteristics

(VDS=5.0V, VG2S=1.5V, ID=10mA)



S-Parameter Data of FET 3SK165

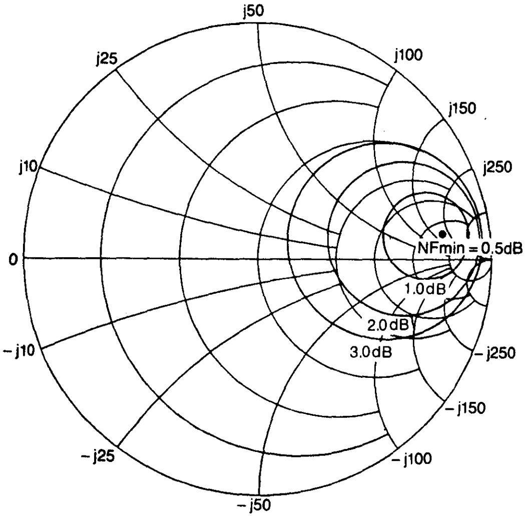
Zo=50Ω

Frequency MHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	.999	– 1.60	2.065	177.40	0.0011	88.48	.961	– .77
200	.998	– 2.97	2.044	172.69	0.0021	93.67	.961	– 1.85
300	.999	– 4.28	2.180	169.86	0.0023	105.04	.971	– 2.98
400	.993	– 5.70	2.077	170.12	0.0049	89.67	.958	– 3.51
500	.989	– 6.98	1.981	167.14	0.0054	83.41	.958	– 4.17
600	.979	– 8.16	1.999	161.04	0.0068	83.94	.960	– 5.09
700	.969	– 9.57	2.004	160.63	0.0082	83.47	.955	– 5.68
800	.958	– 10.84	1.957	159.23	0.0084	82.97	.955	– 6.83
900	.948	– 12.16	1.856	153.88	0.0091	79.56	.948	– 7.22
1000	.938	– 13.23	1.938	150.58	0.0106	78.17	.949	– 8.58
1200	.912	– 15.27	1.789	147.43	0.0131	79.92	.941	– 10.37
1400	.877	– 17.11	1.823	139.04	0.0151	74.26	.936	– 12.06
1600	.841	– 19.12	1.700	137.04	0.0156	78.12	.935	– 13.26
1800	.805	– 21.04	1.704	132.09	0.0171	77.47	.928	– 13.91
2000	.756	– 22.32	1.448	126.14	0.0176	76.07	.922	– 14.46

Noise figure characteristics

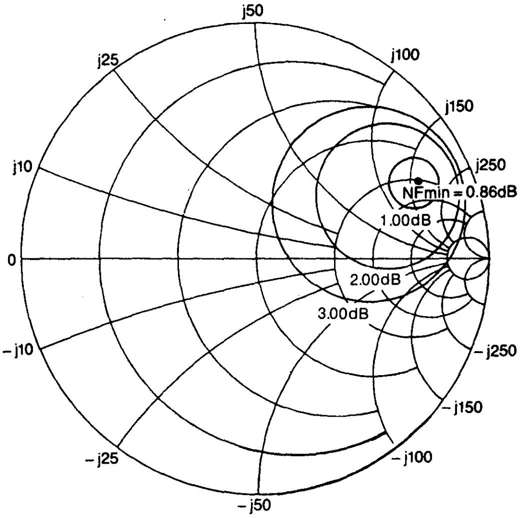
(VDS=5.0V, VG2S=1.5V, ID=10mA)

at 450MHz



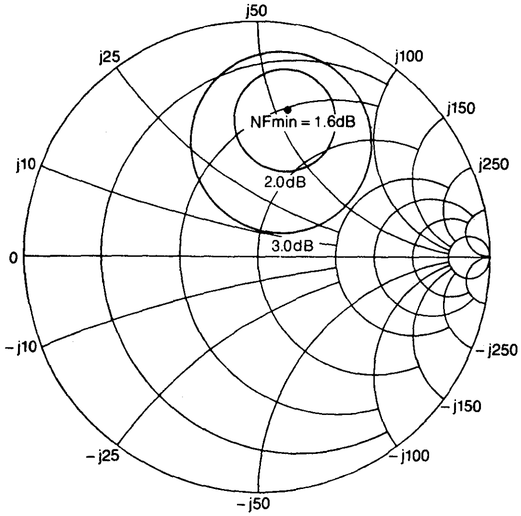
VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 450 MHz
NF min 0.50 dB
Ga 23.83 dB
Gamma (S); MAG 0.799 ANG 7.78°
Gamma (L); MAG 0.887 ANG 7.31°

at 880MHz



VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 880 MHz
NF min 0.86 dB
Ga 23.70 dB
Gamma (S); MAG 0.771, ANG 25.07°
Gamma (L); MAG 0.830, ANG 21.84°

at 2000MHz



Frequency (MHz)	Ga (dB)	NF (dB)	Gamma- S		Gamma- L	
			MAG	ANG	MAG	ANG
400	23.54	0.59	0.824	3.16°	0.910	8.75°
450	23.83	0.50	0.799	7.78°	0.887	7.31°
500	22.79	0.47	0.792	12.03°	0.848	14.56°
880	23.70	0.86	0.771	25.07°	0.830	21.84°
2000	12.92	1.60	0.643	78,48°	0.559	46.00°

VDS = 5.0V
VG2S = 1.5V
ID = 10mA
Frequency 2000 MHz
NF min 1.60 dB
Ga 12.91 dB
Gamma (S); MAG 0.643, ANG 78.48°
Gamma (L); MAG 0.559, ANG 46.00°

SONY **3SK166**

GaAs N-channel Dual-Gate MES FET

Description

The 3SK166 is a GaAs N-channel Dual-Gate MES FET for low noise UHF amplifiers. Low noise and high gain characteristics are accomplished by optimum mask pattern design. Easier high frequency circuits adjustments are made possible by the miniaturized plastic molded package which contributes to reduce parasitic elements of the device.

Features

• Low NF	NF = 1.2 dB (Typ.) at 800 MHz
• High PG	PG = 20 dB (Typ.) at 800 MHz
• High Stability	

Structure

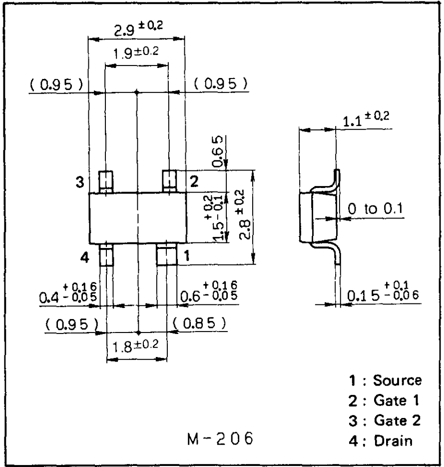
GaAs N-channel Dual-Gate MES (Metal Semiconductor) type FET.

Applications

- UHF Amplifier, oscillator.

Package Outline

Unit: mm



Absolute Maximum Ratings (Ta=25°C)

• Drain to source voltage	V_{DSX}	8	V
• Gate 1 to source voltage	V_{G1S}	−6	V
• Gate 2 to source voltage	V_{G2S}	−6	V
• Drain current	I_D	80	mA
• Channel temperature	Tch	150	°C
• Storage temperature	Tstg	−55 to +150	°C
• Allowable power dissipation	P_D	150	mW

Electrical Characteristics

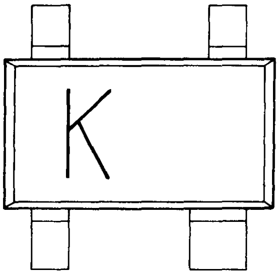
Ta=25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain to source voltage	V_{DSX}	I_D = 100μA V_{G1S} = 0V V_{G2S} = −5V	8			V
Gate 1 cutoff current	I_{G1SS}	V_{G1S} = −5V V_{G2S} = 0V V_{DS} = 0V			−20	μA
Gate 2 cutoff current	I_{G2SS}	V_{G2S} = −5V V_{G1S} = 0V V_{DS} = 0V			−20	μA
Drain saturation current	I_{DSS}*	V_{DS} = 5V V_{G1S} = 0V V_{G2S} = 0V	20		80	mA
Gate 1 cutoff voltage	V_{G1S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G2S} = 0V	-1		-4	V
Gate 2 cutoff voltage	V_{G2S} (OFF)	V_{DS} = 5V I_D = 100μA V_{G1S} = 0V	-1		-4	V
Forward transfer admittance	$\lvert Y_{fs} \rvert$	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1KHz	25	40		mS
Input capacitance	Ciss	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 1MHz		1.3	2.0	pF
Reverse transfer capacitance	Crss			25	40	fF
Power gain	PG	V_{DS} = 5V I_D = 10mA V_{G2S} = 1.5V f = 800MHz	18	20		dB
Noise figure	NF			1.2	2.5	dB

*Classification

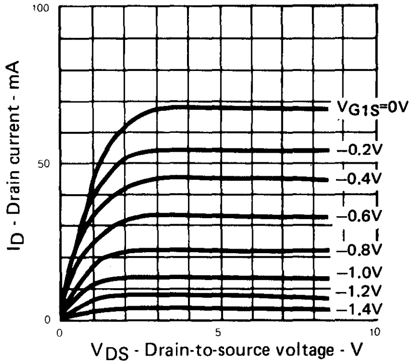
Rank	I_{DSS}	Unit	Rank	I_{DSS}	Unit
3SK166-0	20—80	mA	3SK166-2	30—55	mA
3SK166-1	20—35	mA	3SK166-3	45—80	mA

Mark



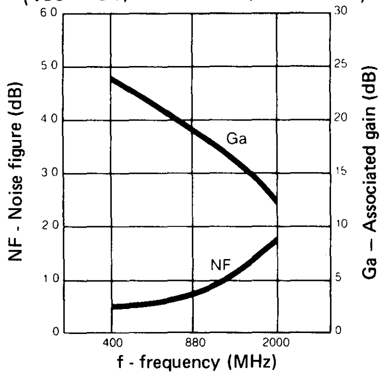
Output characteristics

(Ta=25°C, V_{G2S}=1.5V, V_{G1S}=−0.2V/step)



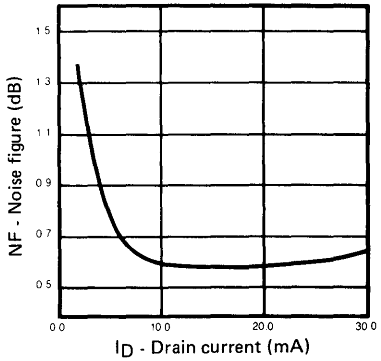
NF, Ga frequency dependence

(V_{DS}=10V, V_{G2S}=1.5V, I_D=10mA)

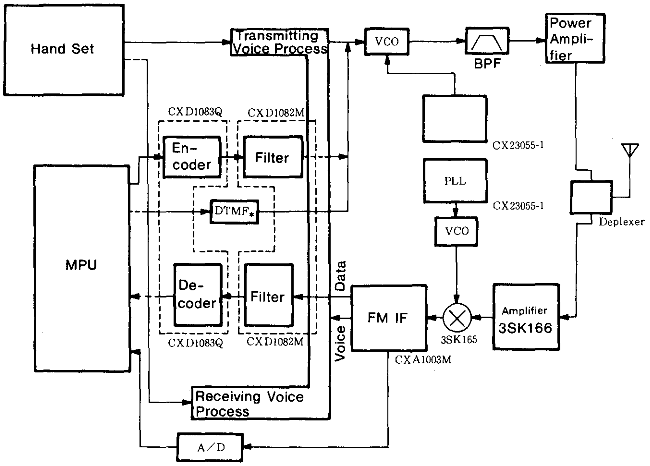


NF-I_D characteristics

(V_{DS}=5.0V, V_{G2S}=1.5V, Frequency at 450MHz)

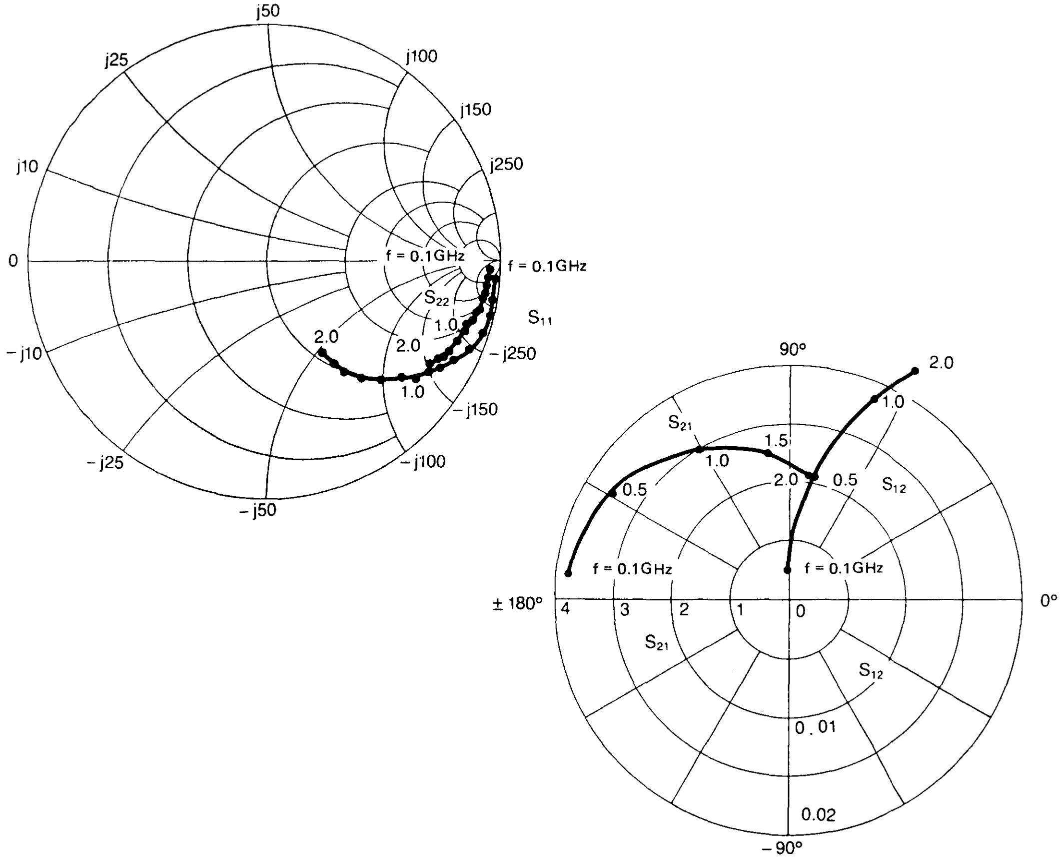


Application Example for Cellular System



S-Parameter vs. Frequency characteristics

(V_{DS}=5.0V, V_{G2S}=1.5V, I_D=10mA)



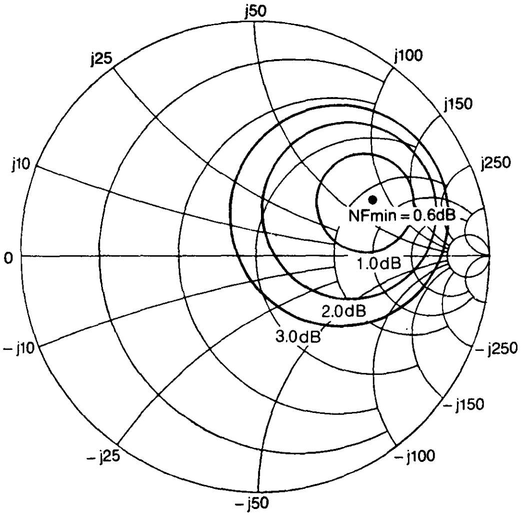
S-Parameter Data of FET 3SK166

Zo=50Ω

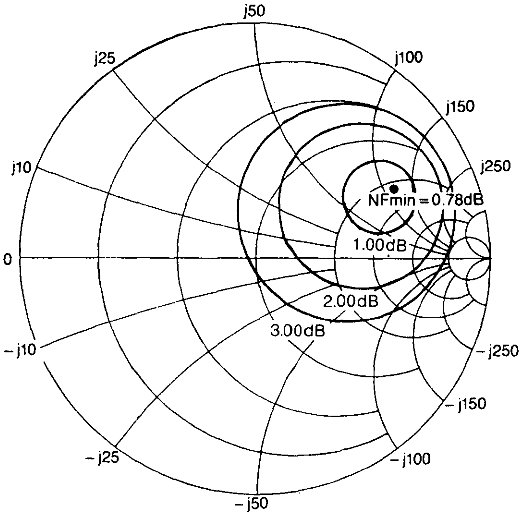
Frequency MHz	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	.997	-4.90	3.815	173.47	0.0025	90.83	.941	-1.80
200	.991	-9.59	3.745	165.74	0.0041	86.98	.939	-4.18
300	.998	-13.04	3.672	161.43	0.0095	84.23	.979	-9.40
400	.959	-18.65	3.647	155.81	0.0105	82.44	.928	-8.23
500	.933	-22.47	3.471	149.90	0.0110	76.78	.925	-9.44
600	.904	-26.50	3.400	141.51	0.0134	76.78	.926	-11.85
700	.873	-30.25	3.311	137.92	0.0153	72.93	.913	-12.87
800	.844	-33.71	3.173	132.54	0.0160	73.56	.912	-15.33
900	.814	-36.72	3.002	125.45	0.0172	69.08	.896	-16.30
1000	.780	-39.35	3.058	120.39	0.0189	66.18	.897	-18.80
1200	.707	-44.48	2.741	112.87	0.0217	65.07	.882	-22.55
1400	.641	-49.20	2.636	103.06	0.0246	60.53	.868	-25.75
1600	.587	-52.59	2.412	95.81	0.0236	61.71	.863	-28.06
1800	.520	-54.29	2.357	88.93	0.0245	62.06	.855	-29.88
2000	.452	-57.35	2.145	80.33	0.0239	60.92	.834	-31.69

Noise figure characteristics

at 450MHz (VV_{DS}=5.0V, V_{G2S}=1.5V, I_D=10mA) at 880MHz

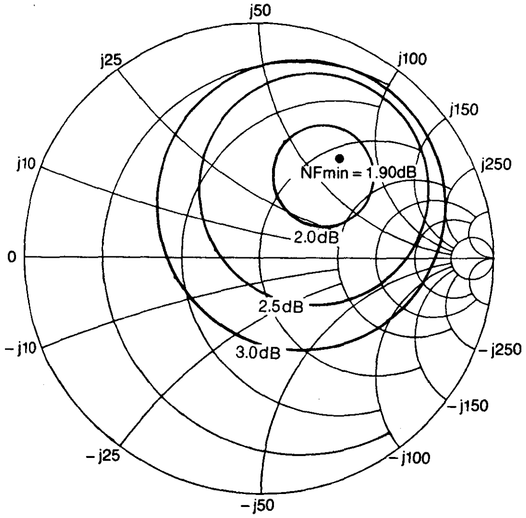


V_{DS} = 5.0V
V_{G2S} = 1.5V
I_D = 10mA
Frequency 450 MHz
NF min 0.60 dB
Ga 23.02 dB
Gamma (S); MAG 0.559 ANG 26.73°



V_{DS} = 5.0V
V_{G2S} = 1.5V
I_D = 10mA
Frequency 880 MHz
NF min 0.78 dB
Ga 19.25 dB
Gamma (S); MAG 0.616, ANG 26.89°

at 2000MHz



Frequency (MHz)	Ga (dB)	NF (dB)	Gamma- S		Gamma- L	
			MAG	ANG	MAG	ANG
400	24.31	0.51	0.689	21.39°	0.902	14.07°
450	23.02	0.60	0.559	26.73°	0.894	16.93°
500	22.43	0.66	0.690	19.49°	0.894	17.93°
880	19.25	0.78	0.616	26.87°		
2000	12.90	1.90	0.542	51.14°		

V_{DS} = 5.0V
V_{G2S} = 1.5V
I_D = 10mA
Frequency 2000 MHz
NF min 1.90 dB
Ga 12.90 dB
Gamma (S); MAG 0.542, ANG 51.14°

Magneto-Resistance Elements

4) Magneto-Resistance Elements (*SDME)

NiCo Thin Film

Type	Application	Feature	Page
DM-106B	Detection of number of revolutions, Other general purposes	General-purpose Type (2.3KΩ Typ.)	187
DM-110	Detection of number of revolutions, Position detection	High resistance Type (280KΩ Typ.)	191
DM-111	Detection of number of revolutions, Position detection	High resistance Type (650KΩ Typ.)	197
DM-211	Detection of revolution speed	Matching with multipole ring magnet (Wavelength=4.52mm) 2-output of phase difference 90°	203

* Sony Divider-type Magneto-Resistance Element

SONY® DM-106B

Magneto-Resistance Element

Description

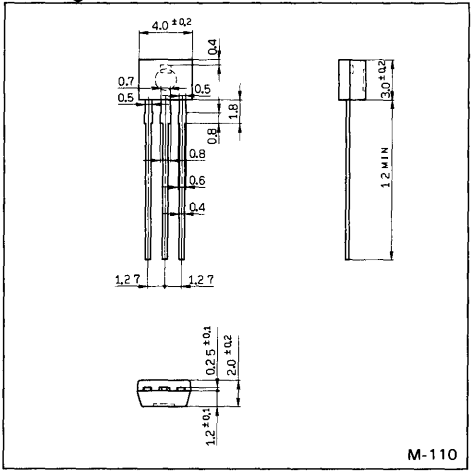
The DM-106B is a highly sensitive magnetoresistance element composed of an evaporated ferromagnetic alloy on a silicon substrate. (The element can be used for automatic shut off of tape recorders, as a contactless switch, and as a general detector of rotational motion.)

Features

• Low power consumption	11 μW (Typ.) Vcc = 5V
• Low magnetic field and high sensitivity	80 mVp-p (Typ.) Vcc = 5V H = 100 Oe
• High reliability Ensured through silicon Nitride protective filming	

Package Outline

Unit: mm



Structure

Thin-film nickel-cobalt magnetic alloy on silicon substrate

Absolute Maximum Ratings (Ta = 25°C)

• Supply voltage	Vcc	10	V
• Operating temperature	Topr	−40 to +100	°C
• Storage temperature	Tstg	−50 to +125	°C

Recommended Operating Condition

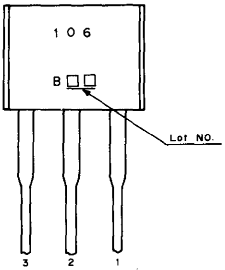
• Supply voltage	Vcc	5	V

Electrical Characteristics

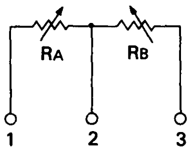
Ta = 25°C

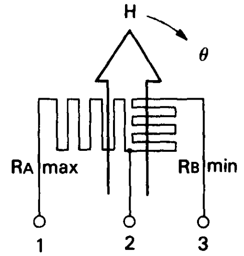
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total resistance	R_T	Vcc = 5V, H = 100 Oe, Revolving magnetic field	1.4	2.3	3.7	kΩ
Midpoint potential	Vc	Vcc = 5V, H = 100 Oe, Revolving magnetic field	2.45	2.50	2.55	V
Output voltage	Vo	Vcc = 5V, H = 100 Oe, Revolving magnetic field	60	80		mVp-p

Mark



Equivalent Circuit



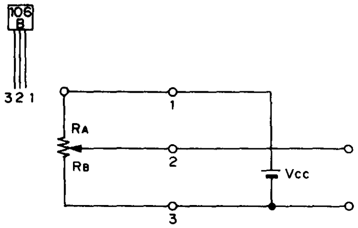


RA: Resistance reduces as the magnetic field revolves.

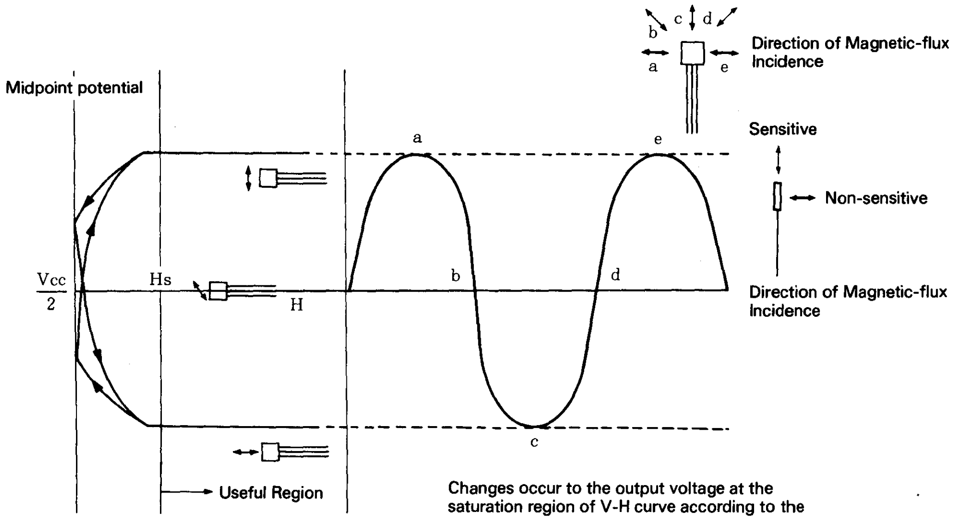
RB: Resistance increases as the magnetic field revolves.

Introduction

1. Power supply pin and Output pin



2. Sensitive direction vs. Midpoint potential

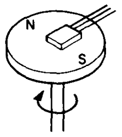


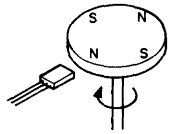
Changes occur to the output voltage at the saturation region of V-H curve according to the direction of magnetic flux.
These changes provide for the operation.

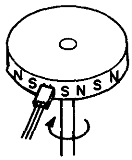
- With one rotation of magnetic flux, signals for 2 periods are obtained.

Applications

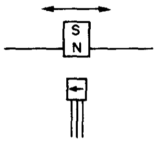
1. Detection of revolution



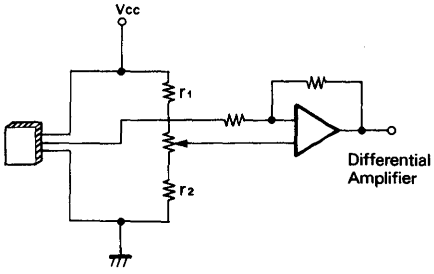




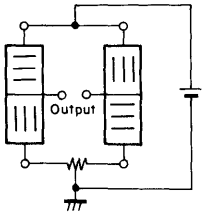
2. Position detecting

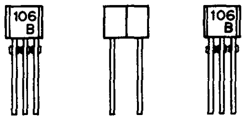


Circuits



3. Bridge Circuits



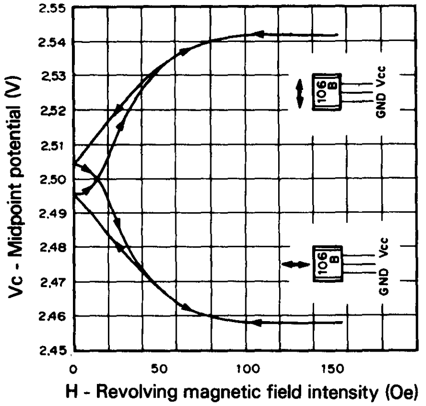


By coupling 2 pieces back to back and sticking them together in a bridge, the output voltage is doubled.

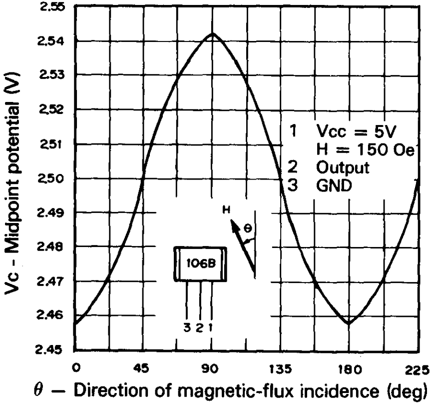
Notes on Application

- Execute the solder of the lead line within 10 seconds at a temperature below 260°C.
- To Fix the ELEMENTS: When glue is used, DO NOT apply mechanical stress to the elements.

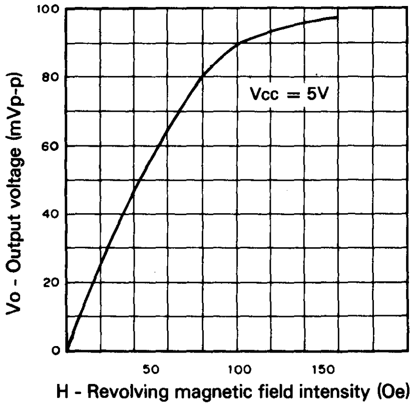
Midpoint potential vs. Magnetic field intensity



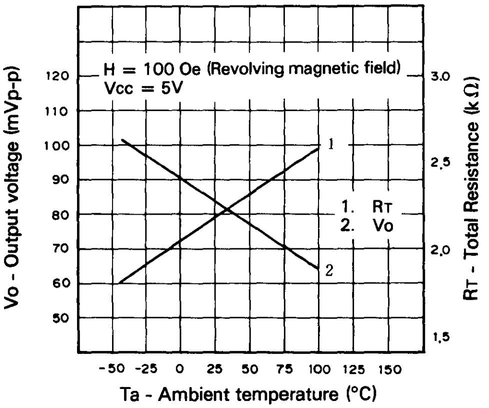
Midpoint potential vs. Direction of magnetic-flux incidence



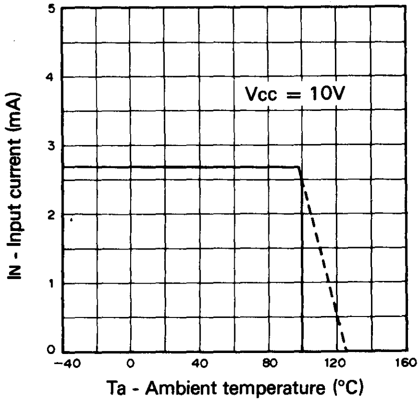
Output voltage vs. Magnetic field intensity



Total resistance, output voltage vs. Temperature



Derating Curve



SONY DM-110

Magneto-Resistance Element

Description

The DM-110 is a highly sensitive magneto resistance element, composed of an evaporated ferromagnetic alloy on a silicon substrate. The element can be used for detection of rotational speed and for detection of angle of rotation and as a detection of position.

Features

- Low power consumption
  90 μW (Typ.) at Vcc = 5V
- Low magnetic field and high sensitivity
  50 mp-p (Typ.) at Vcc = 5V and H = 50 Oe
- High reliability
  Ensured through silicon
  Nitride protective filming

Absolute Maximum Ratings (Ta = 25°C)

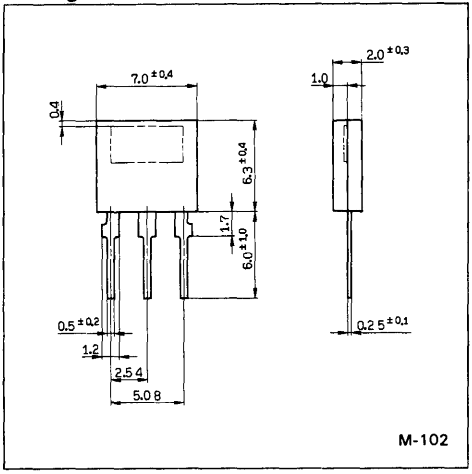
• Supply voltage	Vcc	10	V
• Operating temperature	Topr	−40 to +80	°C
• Storage temperature	Tstg	−50 to +100	°C

Recommended Operating Condition

• Supply voltage	Vcc	5	V

Package Outline

Unit: mm

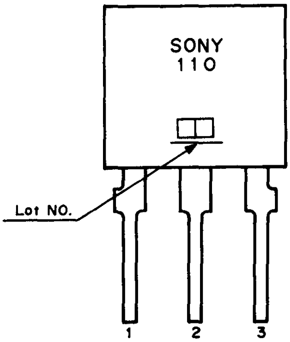


Electrical Characteristics

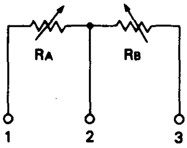
Ta = 25°C

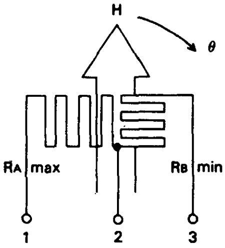
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total resistance	RT	H = 50 Oe, θ = 45°	200	280	350	kΩ
Midpoint potential	Vc	Vcc = 5V, H = 50 Oe Revolving magnetic field	2.45	2.50	2.55	V
Output voltage	Vo	Vcc = 5V, H = 50 Oe Revolving magnetic field	30	50		mVp-p

Mark



Equivalent Circuit



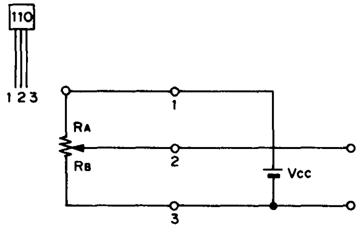


RA: Resistance reduces as the magnetic field revolves.

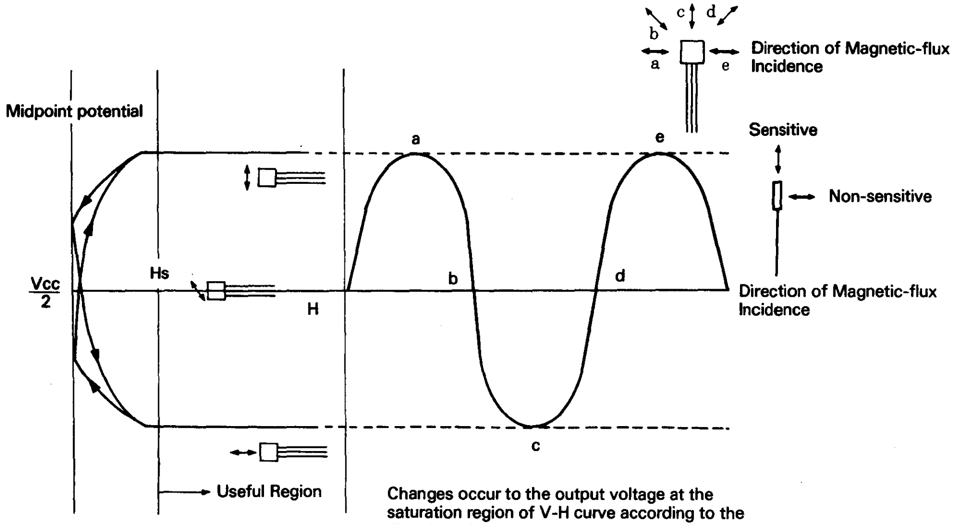
RB: Resistance increases as the magnetic field revolves.

Introduction

1. Power supplying pin and output pin



2. Sensitive direction vs. Midpoint potential

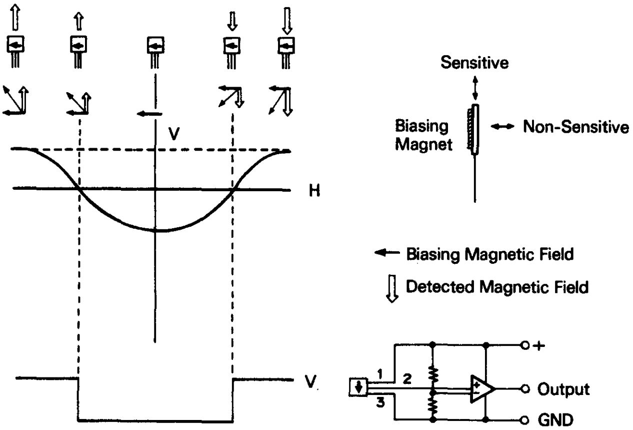


Changes occur to the output voltage at the saturation region of V-H curve according to the direction of magnetic flux.

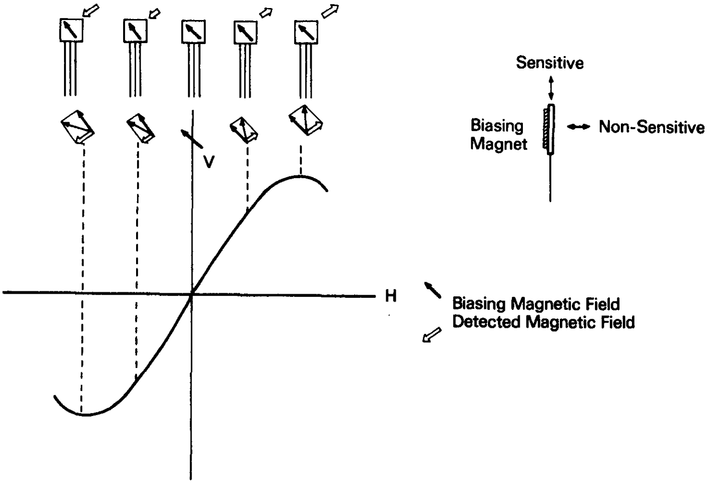
These changes provide for the operation

- With one rotation of magnetic flux, signals for 2 periods are obtained.

3. 0° Biasing magnetic field
   (Switching use)

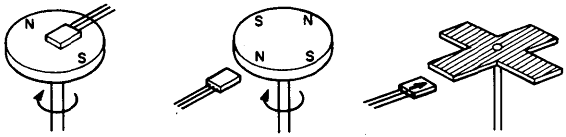


4. 45° Biasing magnetic field
   (Analogue use)

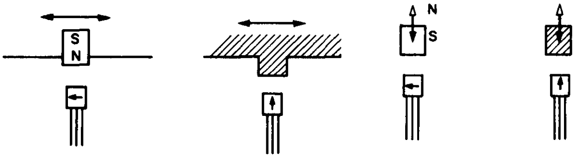


Applications

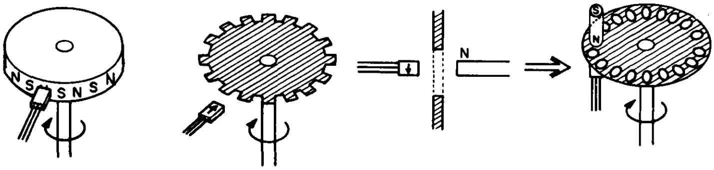
1. Detection of revolution



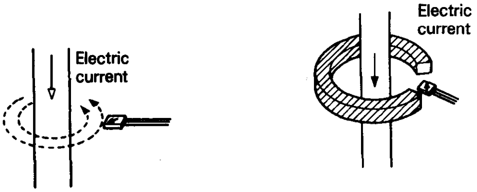
2. Position detecting



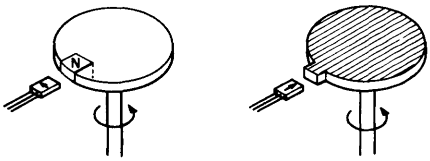
3. Angular detection of rotating wheel



4. Reading out of analog value



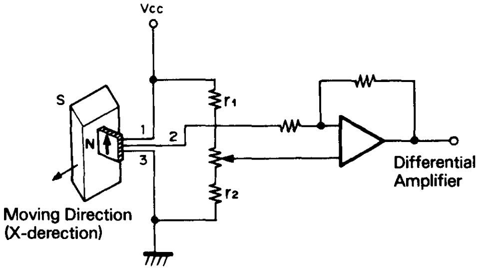
5. Position detecting of revolving element

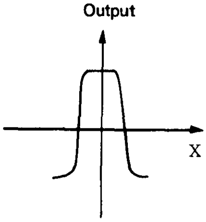


▨ Magnetic conductors

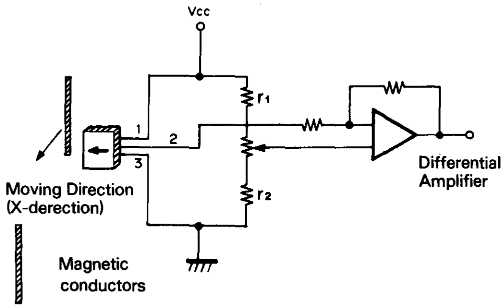
Circuit Examples

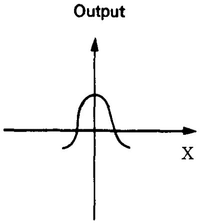
(See Applications 2, 3, 5)



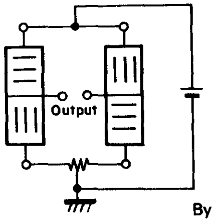


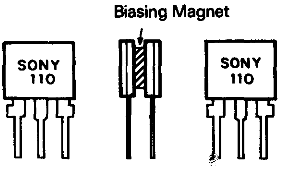
(See Applications 1, 2, 3, 5)





Bridge Construction





By coupling 2 pieces back to back and sticking them together in a bridge, the output voltage is doubled.

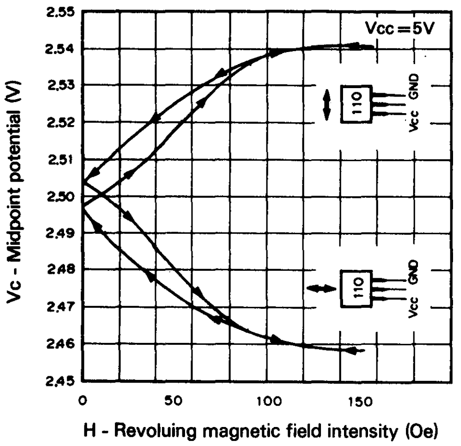
How to Make a Biasing Magnetic Field

- Stick a rubber or ferrite biasing magnet.
- Position an element between the poles of the permanent magnet.

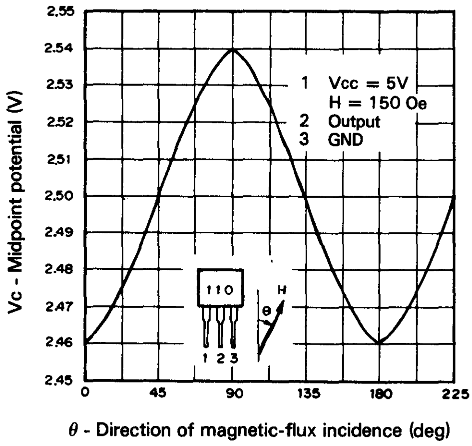
Notes on Application

- Execute the solder of the lead line within 10 seconds at a temperature below 250°C.
- To Fix the ELEMENTS: When glue is used, DO NOT apply mechanical stress to the elements.

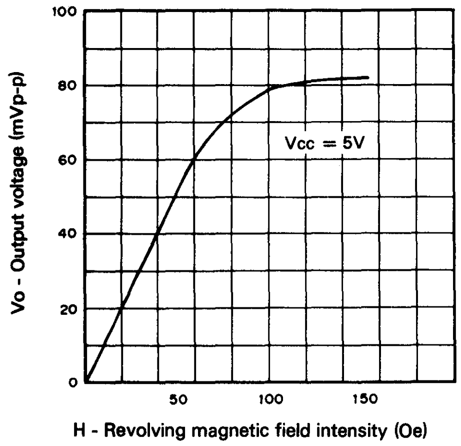
Midpoint potential vs. Magnetic field intensity



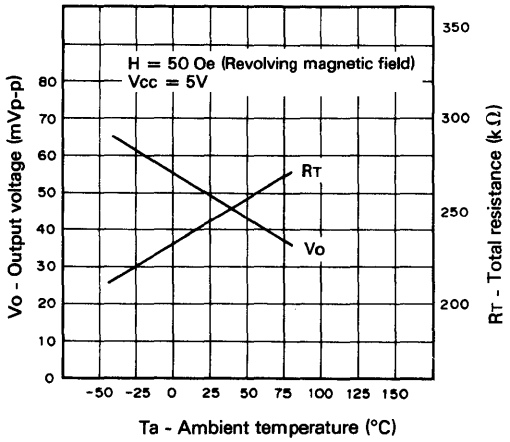
Midpoint potential vs. Magnetic-flux incidence



Output voltage vs. Magnetic field intensity



Output voltage vs. Temperature



SONY DM-111

Magneto-Resistance Element

Description

The DM-111 is a highly sensitive magnetic resistance element, composed of an evaporated ferromagnetic alloy on a silicon substrate. The element can be used for detection of rotational speed and for detection of angle of rotation and as a detection of position.

Features

- Low power consumption
  38 μW (Typ.) at $V_{CC} = 5V$
- Low magnetic field and high sensitivity
  75 mVp-p (Typ.) at $V_{CC} = 5V$ and $H = 50$ Oe
- High reliability

Absolute Maximum Ratings (Ta = 25°C)

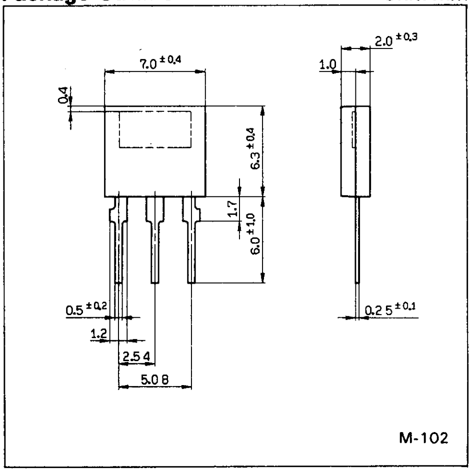
• Supply voltage	V_{CC}	10	V
• Operating temperature	Topr	−40 to +80	°C
• Storage temperature	Tstg	−50 to +100	°C

Recommended Operating Condition

• Supply voltage	V_{CC}	5	V

Package Outline

Unit: mm

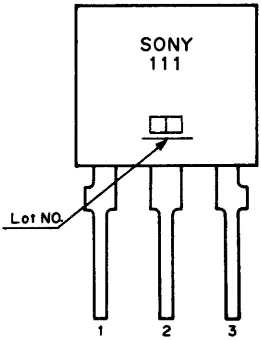


Electrical Characteristics

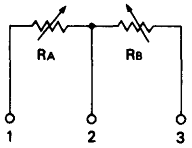
Ta = 25°C

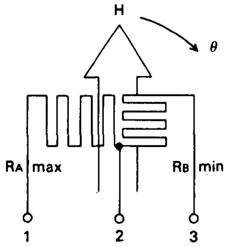
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total resistance	R_T	$H = 50$ Oe, $\theta = 45°$	500	650	800	kΩ
Midpoint potential	V_C	$V_{CC} = 5V$, $H = 50$ Oe Revolving magnetic field	2.47	2.50	2.53	V
Output voltage	V_O	$V_{CC} = 5V$, $H = 50$ Oe Revolving magnetic field	30	75		mVp-p

Mark



Equivalent Circuit



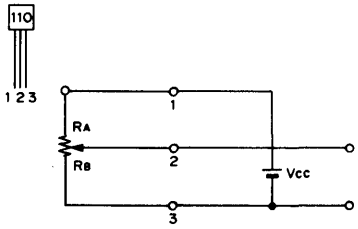


RA: Resistance reduces as the magnetic field revolves.

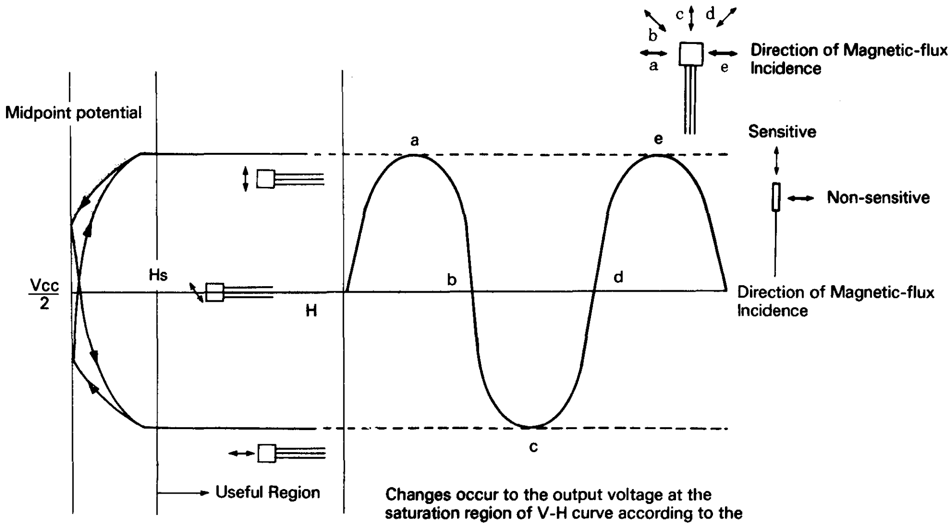
RB: Resistance increases as the magnetic field revolves.

Introduction

1. Power supplying pin and output pin



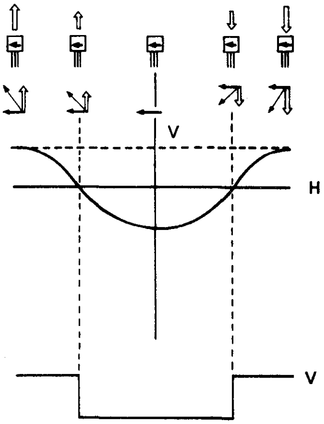
2. Sensitive direction vs. Midpoint potential

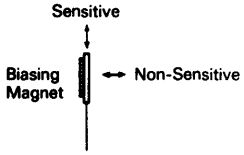


Changes occur to the output voltage at the saturation region of V-H curve according to the direction of magnetic flux.
These changes provide for the operation

- With one rotation of magnetic flux, signals for 2 periods are obtained.

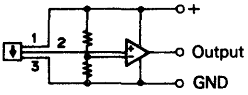
3. 0° Biasing magnetic field (Switching use)



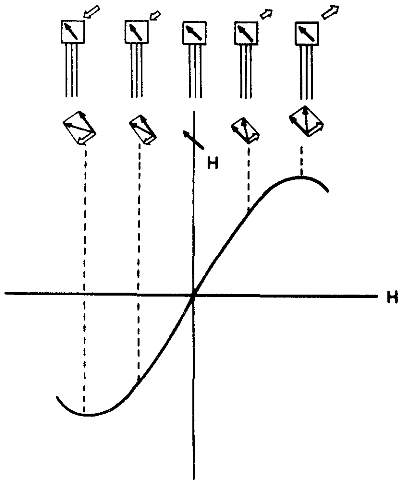


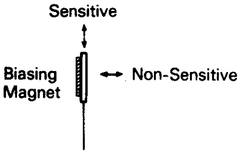
← Biasing Magnetic Field

⇩ Detected Magnetic Field



4. 45° Biasing magnetic field (Analog use)



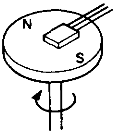


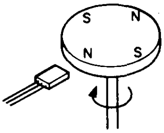
↖ Biasing Magnetic Field

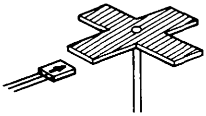
⇙ Detected Magnetic Field

Applications

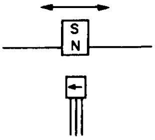
1. Detection of revolution

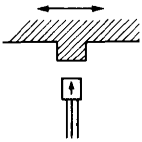




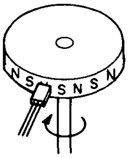


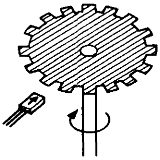
2. Position detecting

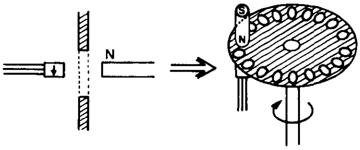




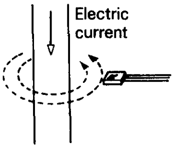
3. Angular detection of rotating wheel

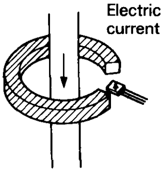


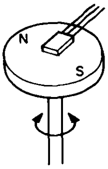




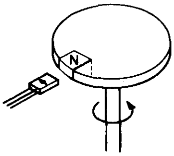
4. Reading out of analog value

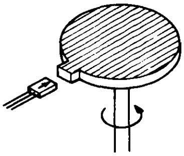






5. Position detecting of revolving element

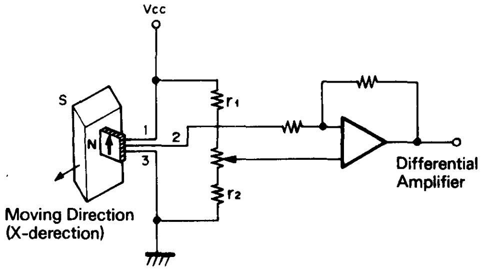


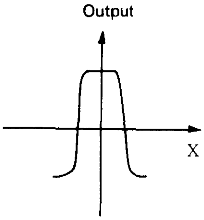


▨ Magnetic conductors

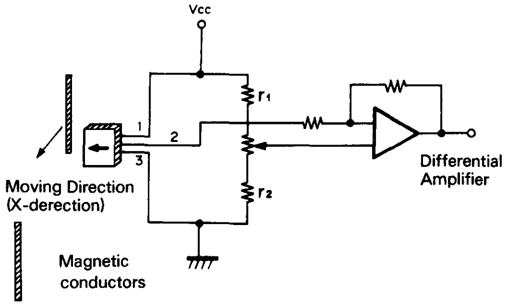
Circuits

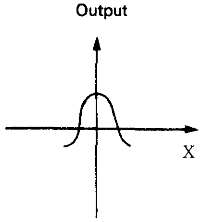
2, 3, 5



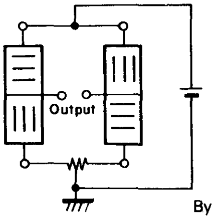


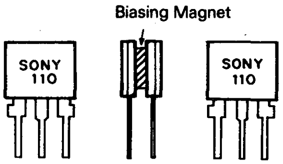
1, 2, 3, 5





Bridge Circuits





By coupling 2 pieces back to back and sticking item together in a bridge, the output voltage is doubled.

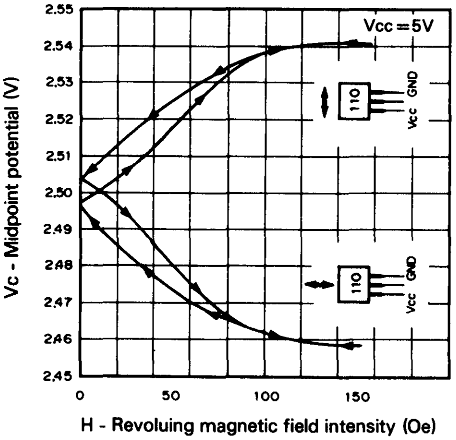
How to Make a Biasing Magnetic Field

- Stick a rubber or ferrite biasing magnet.
- Position an element between the poles of the permanent magnet.

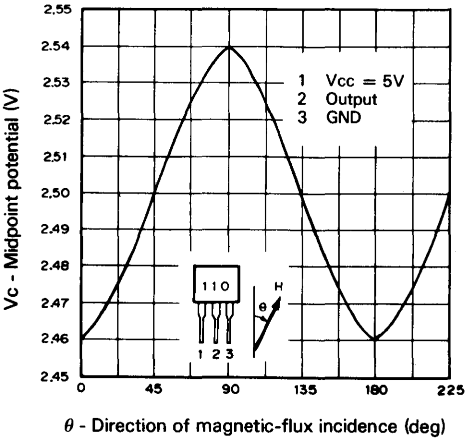
Notes on Application

- Execute the solder of the lead line within 10 seconds at a temperature below 260°C.
- To Fix the ELEMENTS: When glue is used, DO NOT apply mechanical stress to the elements.

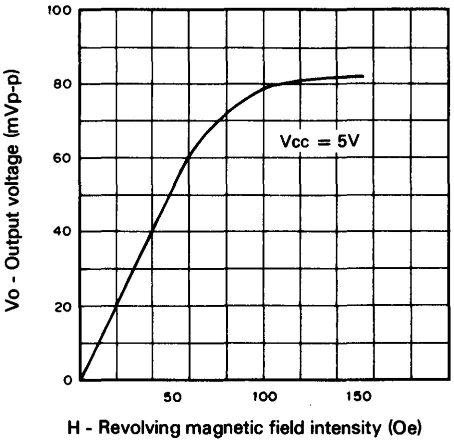
Midpoint potential vs. Magnetic field intensity



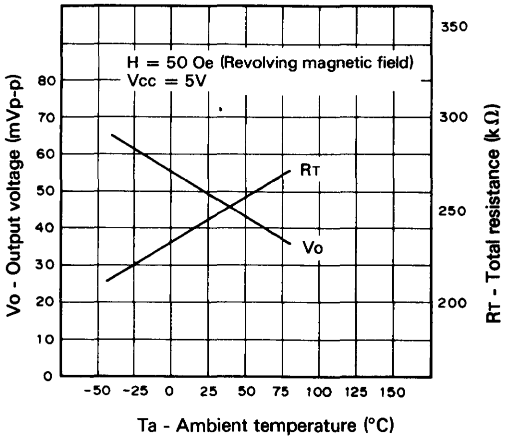
Midpoint potential vs. Magnetic-flux incidence



Output voltage vs. Magnetic field intensity



Total resistance, output voltage vs. Temperature



SONY® **DM-211**

Magneto-Resistance Element

Description

The DM-211 highly sensitive magneto resistance element, composed of an evaporated ferromagnetic alloy on a silicon substrate.

This element can be used for detection of rotational speed and for detection of direction of rotation.

Features

- Low magnetic field and high sensitivity
  75mVp-p (Typ.) at Vcc = 5V
  and H = 100 Oe

Absolute Maximum Ratings (Ta = 25°C)

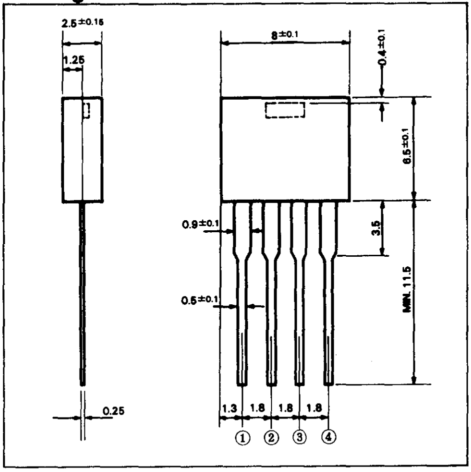
• Supply voltage	Vcc	10	V
• Operating temperature	Topr	−20 to +120	°C
• Storage temperature	Tstg	−50 to +150	°C

Recommended Operating Condition

• Supply voltage	Vcc	5	V

Package Outline

Unit: mm

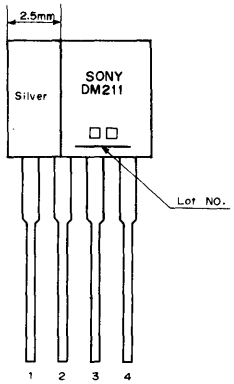


Electrical Characteristics

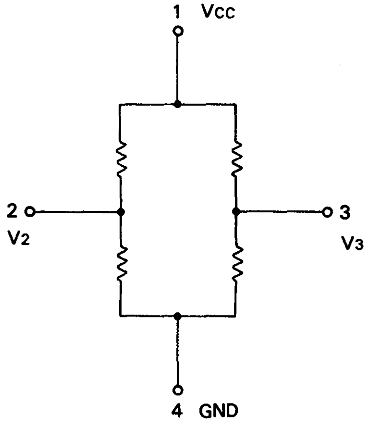
Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total resistance	R_T	H = 100 Oe θ = 45° Vcc = 5V	1.6		3.0	kΩ
Midpoint potential	V_2, V_3	Revolving magnetic field H = 100 Oe Vcc = 5V	2.475		2.525	V
Midpoint potential difference	ΔV_{2-3}	Revolving magnetic field H = 100 Oe Vcc = 5V	−25		25	mV
Hysteresis voltage	V_H	Revolving magnetic field H = 100 Oe Vcc = 5V			5	mV
Output voltage	V_{OUT}	Revolving magnetic field H = 100 Oe Vcc = 5V	50	75		mVp-p
FG irregular of rotation		See the Electrical Characteristic Test Circuit (Page 4)		0.03		%

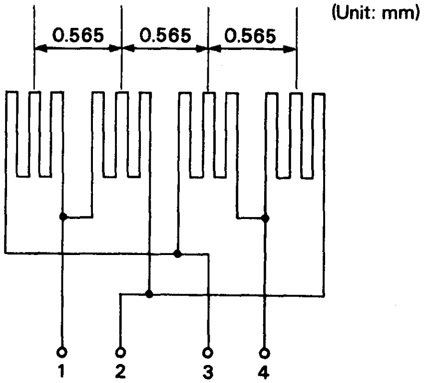
Mark



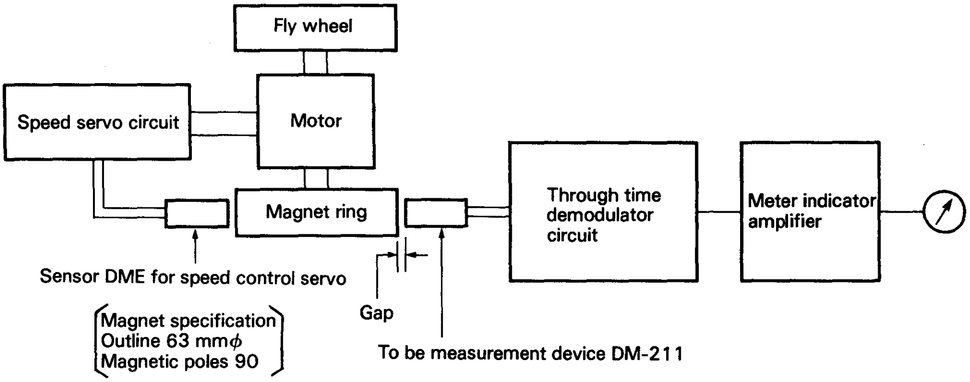
Equivalent Circuit



Pattern Layout

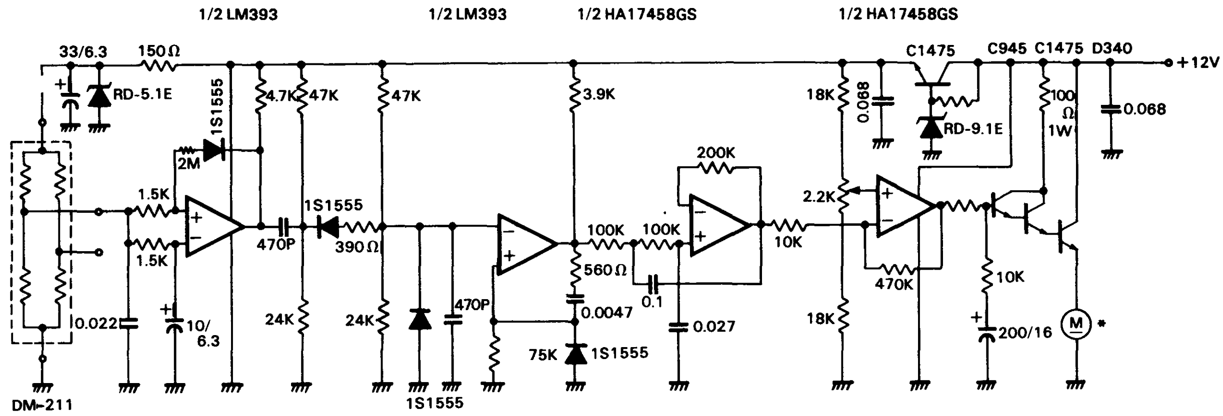


FG Irregular of Rotation Test Circuit



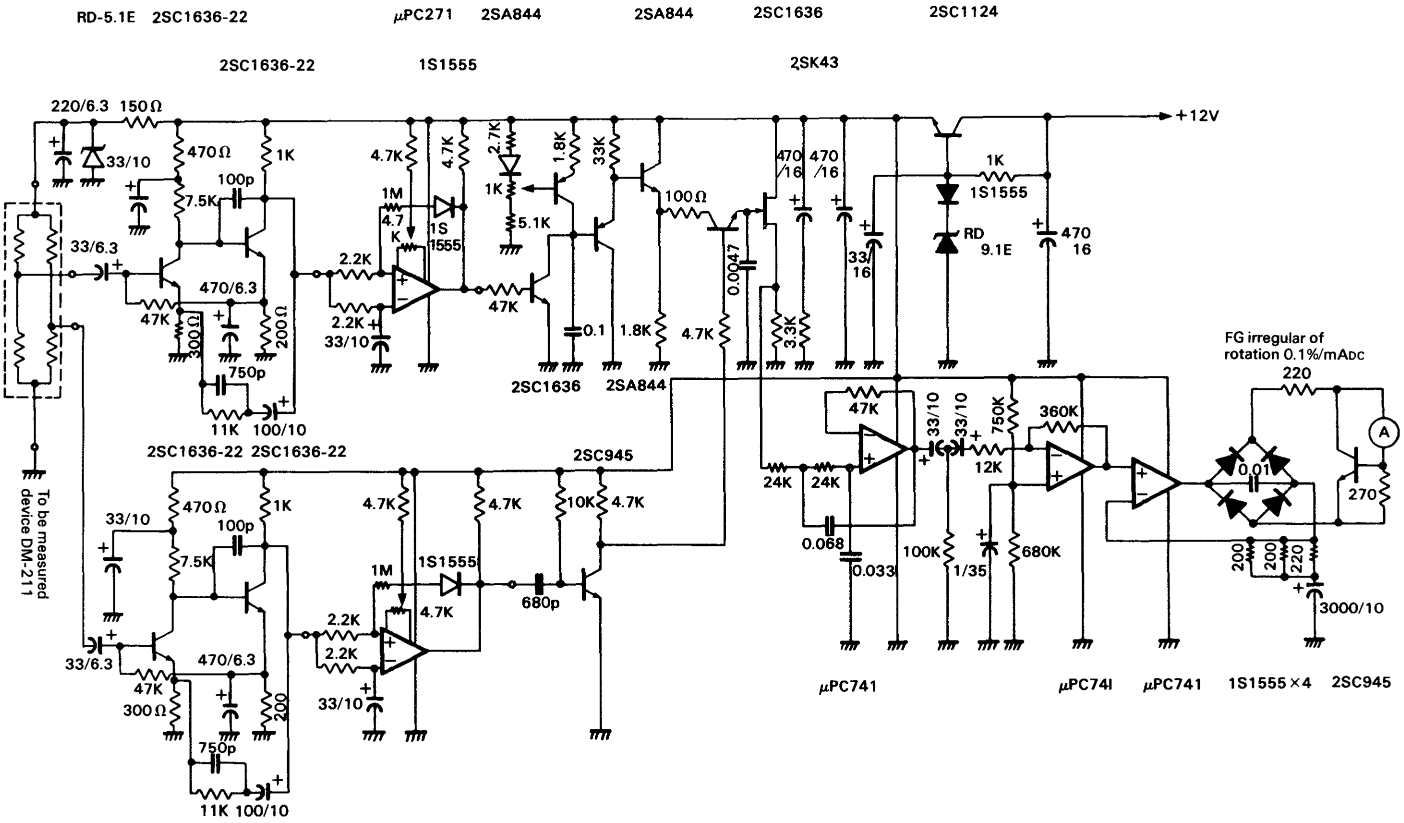
Electrical Characteristic Test Circuit

(Speed servo circuit)

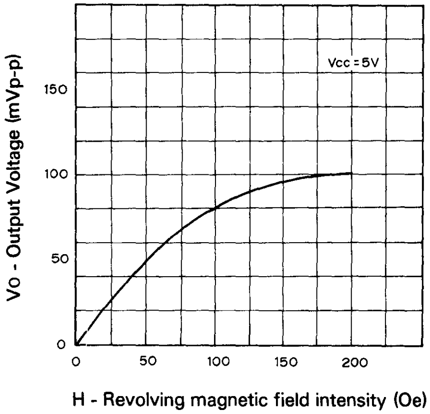


* Motor must be used with fly wheel (I = 12g·Cm·S²)

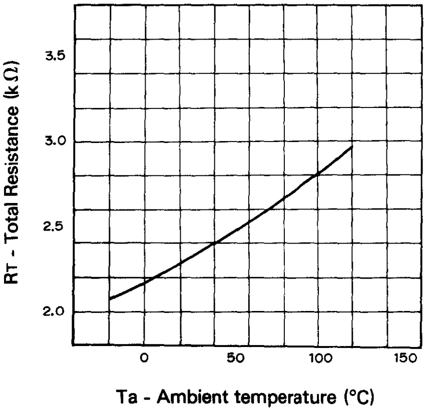
(Through the Time Demodulator Circuit and Meter Indicator Amplifier Circuit)



Output voltage vs. Magnetic field intensity



Total resistance vs. Ambient temperature

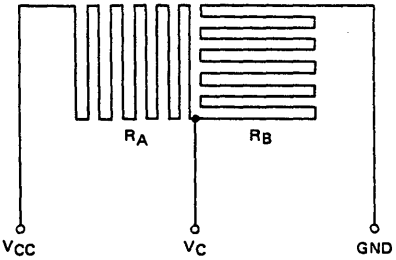


Application Notes

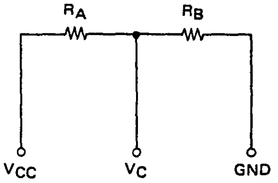
Sony Divider-type Magnetoresistance Element

Orthogonal Pattern SDME

1. Basic structure

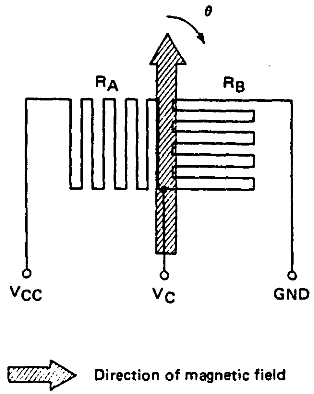


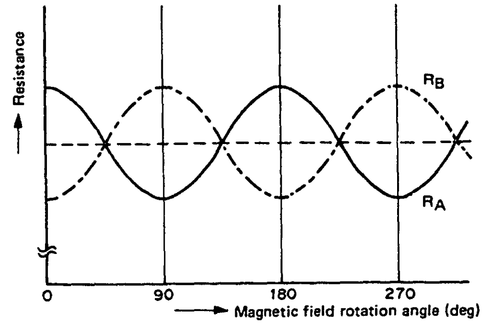
Equivalent circuit



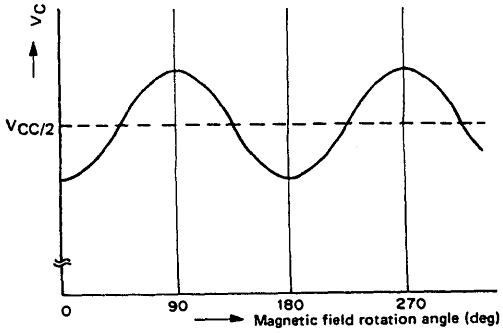
2. Basic performance

The resistance of left/right elements changes according to the rotation of the external magnetic field.





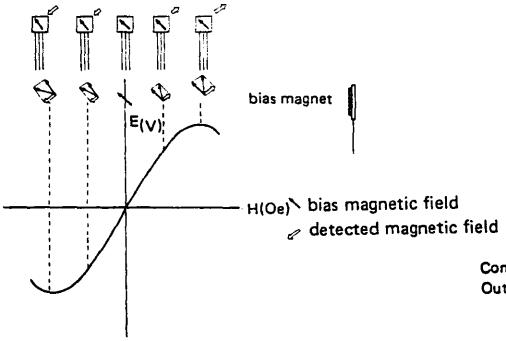
Accordingly sinewave output is obtained as in figure on the right.



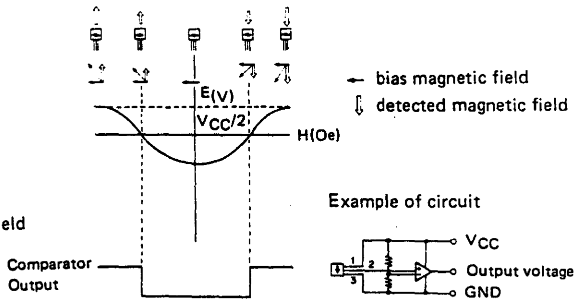
3. Basic performance using bias magnetic field

1) External magnetic field detection

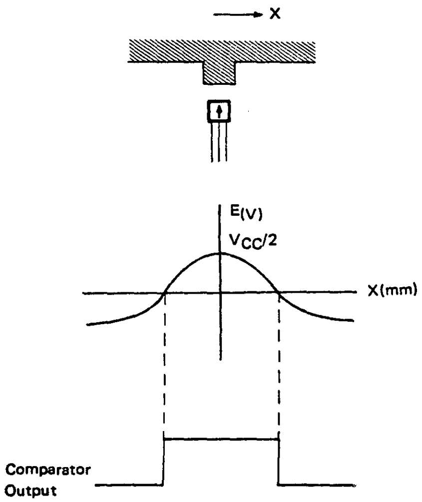
When using a 45° bias magnetic field

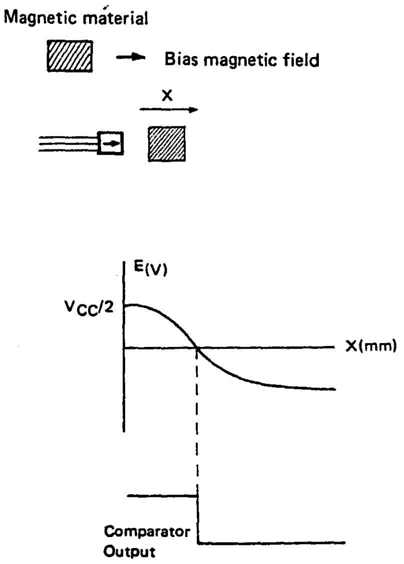


When using 0° bias magnetic field

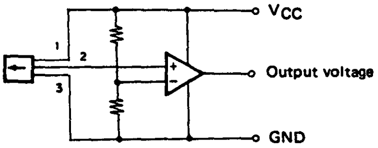


2) Detection of external magnetic material



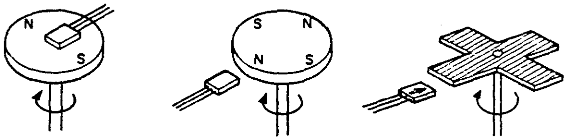


Example of circuit

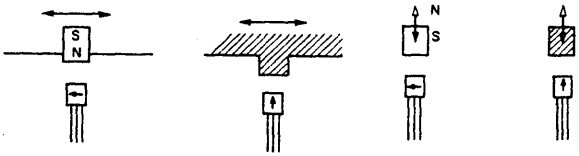


4. Basic application

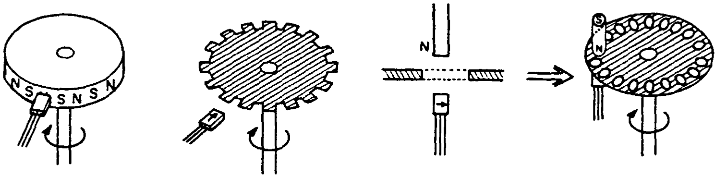
1) Detection of number of revolutions.



2) Position detection.

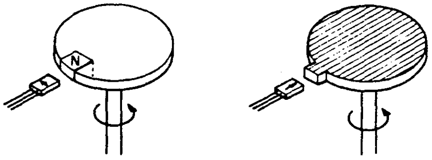


3) Angle detection of revolving material.



4) Reading of current and other values.

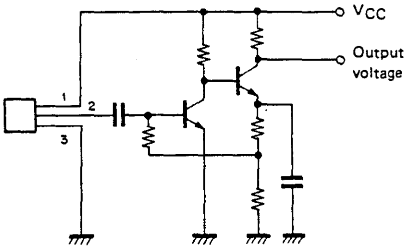
5) Position detection of revolving material.



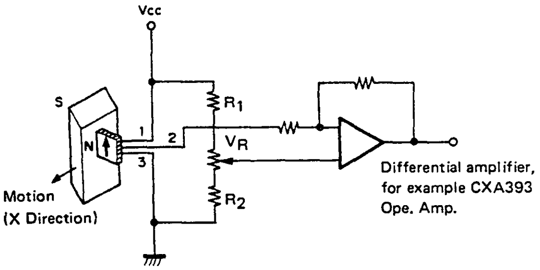
▨ Magnetic material

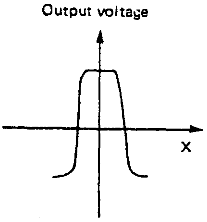
Examples of detection circuits

1), 5)

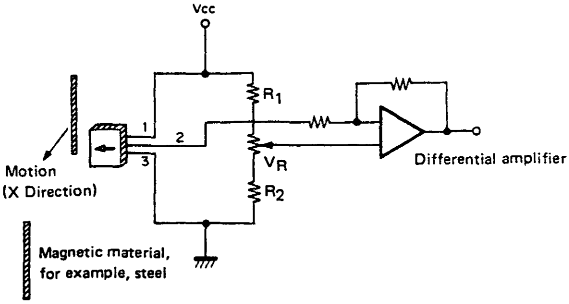


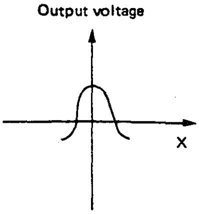
2), 3), 5)

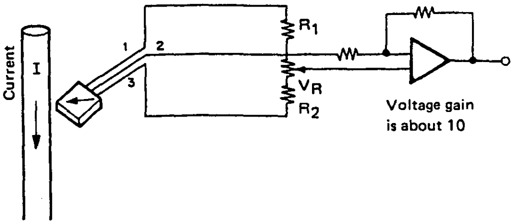




1), 2), 3), 5)



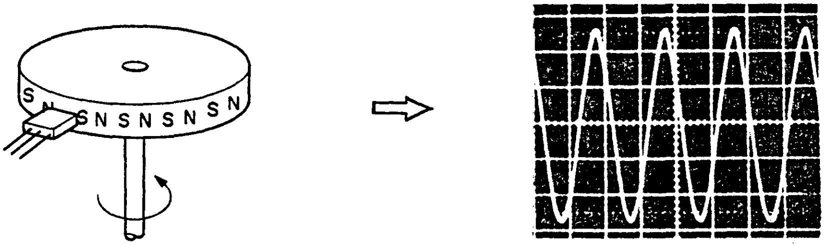




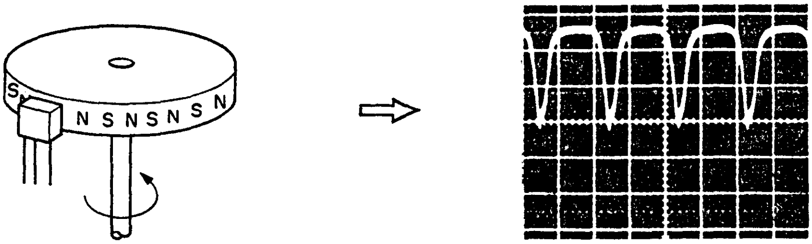
5. Examples of output waveform (using DM-106B)

1) Output waveform resulting from the difference in positioning between the rotary magnetic field generator and SDME.

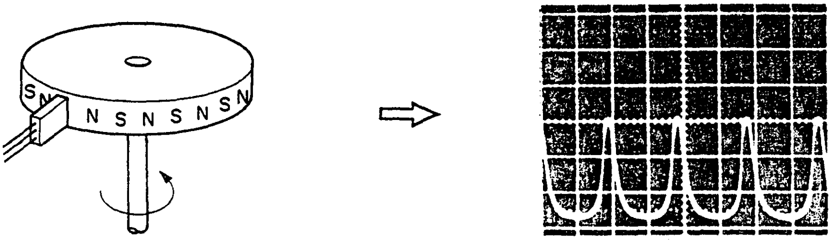
(a)



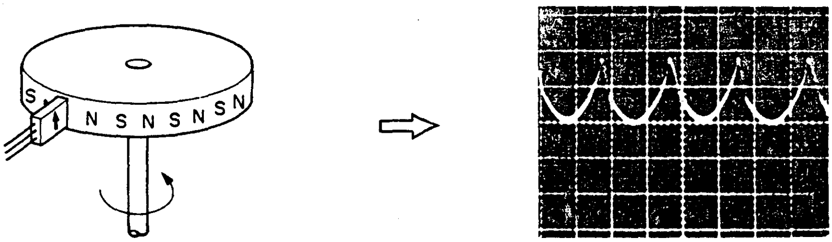
(b)



(c)

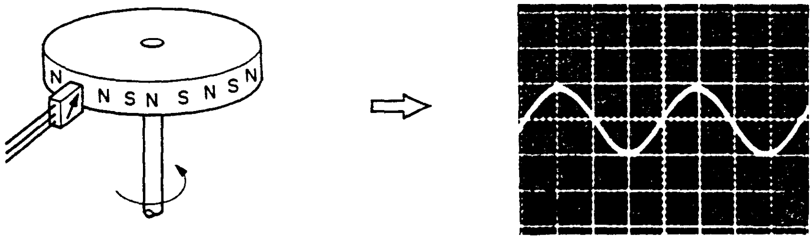


(d)

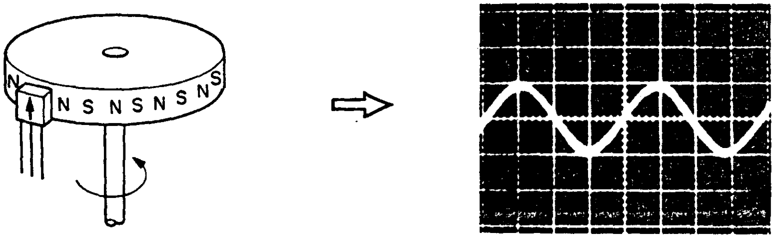


Note) Unit: vertical 20 mV/div
horizontal 500 μs/div

(e)

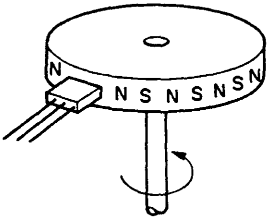


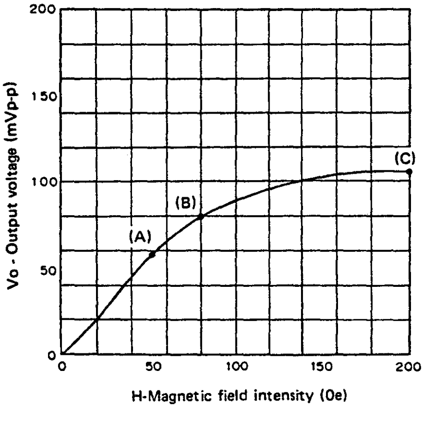
(f)



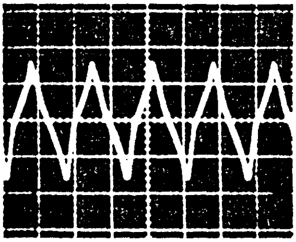
Note) Rotary magnetic field generator in usage: 63 mmϕ, 30 poles; or (d), (e), (f) use a bias magnet.

2) Magnetic field intensity vs. output waveform (For 1 and (a) cases)

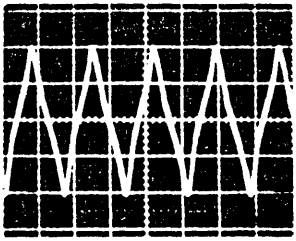




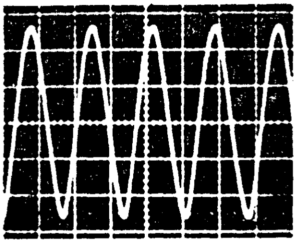
(A) H≃ 50 (Oe)



(B) H≃ 80 (Oe)

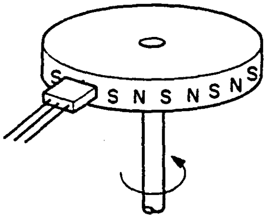


(C) H≃ 200 (Oe)

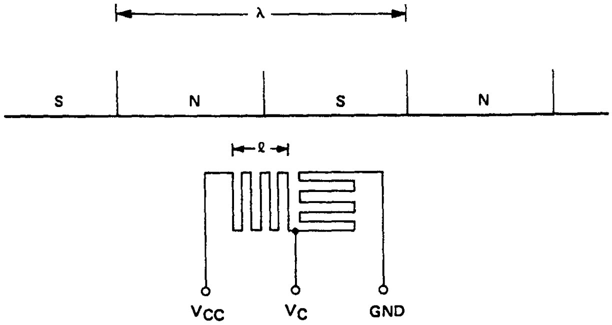


Note) Unit: vertical 20 mV/div, horizontal 500 μs/div

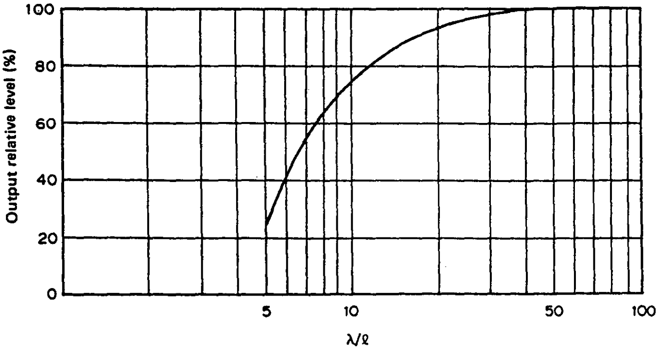
6. Detectable magnetic wavelength range (for 5, 1), (a) cases)



Magnified diagram



Output relative level vs. λ/ℓ



Note) Assuming saturating magnetic intensity is sufficient
DM-106B .... ℓ=0.2 mm
DM-110, DM-111 ..... ℓ=2.25 mm

7. Practical application

Tape end detection circuit through SDME.

A practical example of waveform processing IC, CX10006

CX10006 features a built-in amplifying circuit, constant voltage circuit and mute drive circuit. Used in conjunction with SDME allows for the realization of tape end detection circuit with minimum space requirements. (Refer to Fig. 1)

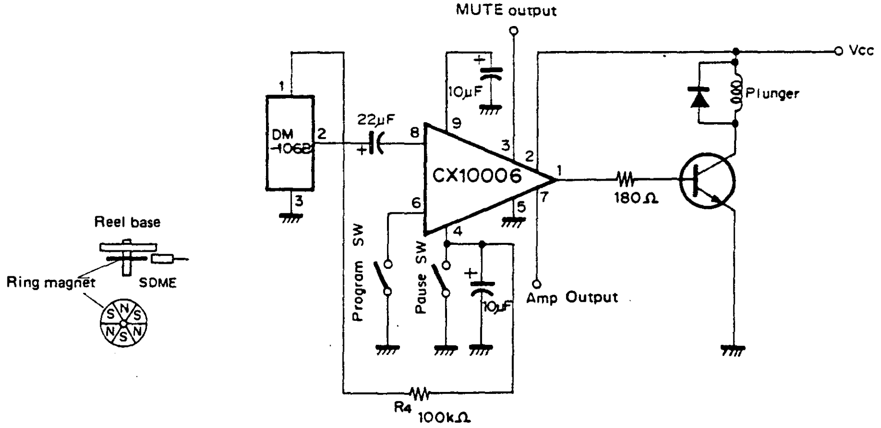
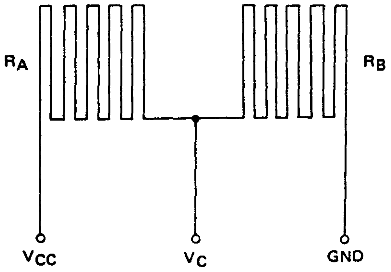
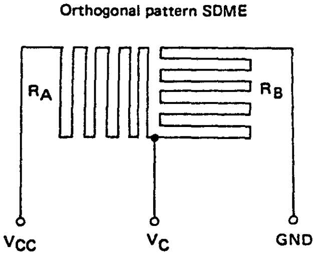


Fig. 1

Parallel Pattern SDME

1. Basic structure

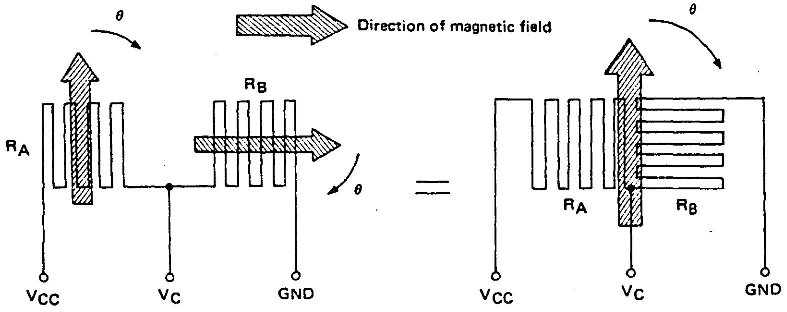




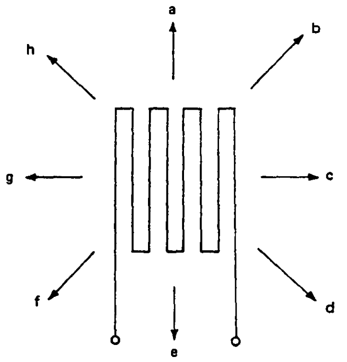
By applying different magnetic fields to RA and RB, an output signal is obtained as a variation of Vc. (With the orthogonal pattern SDME a uniform magnetic field is applied to the component as a whole)

2. Basic performance

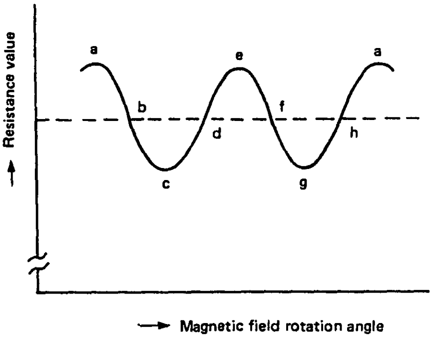
By applying to RA and RB different rotating magnetic fields at a 90° angle, an output equivalent to that of the orthogonal pattern SDME can be obtained.



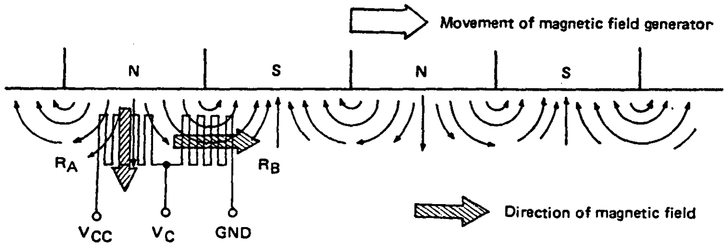
3. External magnetic field direction vs. Components resistance value



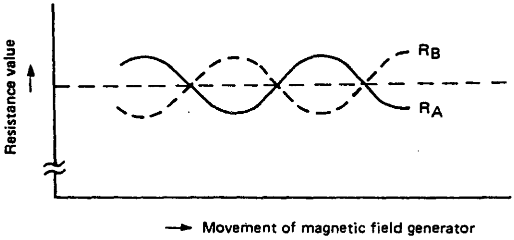
Arrow indicates external magnetic field direction

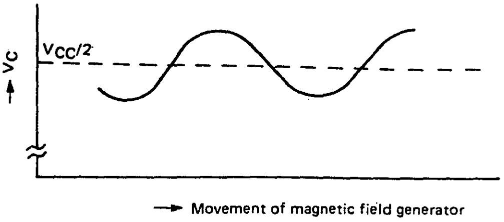


4. Basic using method and output waveform



As shown in above figure, synchronous magnetic field is detected.





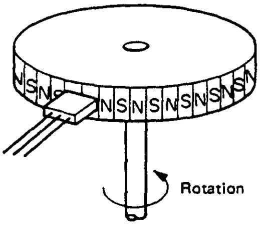
To obtain such an output, the relation between the wavelength of the magnetic field generator and the pattern pitch of the SDME should be as shown above. Accordingly the parallel pattern SDME becomes basically a customized item.

When the relation between the magnetized wavelength and the pattern pitch is disturbed, a change occurs in the output waveform. This change will be referred to later. (See Section 7.)

With the orthogonal pattern SDME, the detection of synchronous magnetic field is similarly possible. However, with the parallel pattern SDME, as the wavelength of the magnetic field generator can be made shorter, high precision in position and rotation detection, can be achieved.

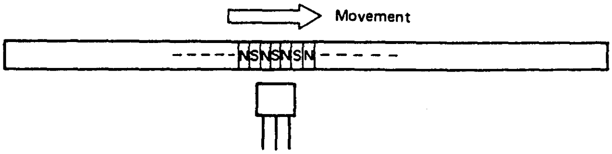
5. Basic application

1) Rotation speed and Rotation angle detection



Usage of the orthogonal SDME is similar. However, the parallel pattern SDME can handle with higher precision magnetic field generators.
Example: Detection of capstan motor rotation speed for VTR

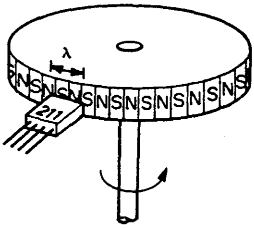
2) Position and speed detection

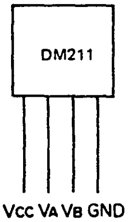


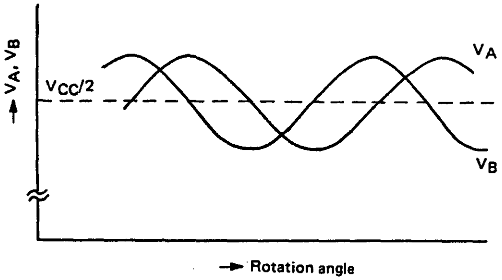
Example: Magnetic scale

6. Practical application

The general purpose type of parallel pattern SDME, DM-211 outputs 2 phases with 90° phase difference. The optimum magnetic wavelength is 4.52 mm.







By processing the two outputs V_A and V_B at the circuit shown in Fig. 1., as a square waveform pulse with a constant pulse width and a doubled frequency can be obtained, the detection resolution can be raised.

By processing the waveform at the circuit shown in Fig. 2, the detection of normal and reverse rotation can also be accomplished. This by applying a single-shot multivibrator to one of the outputs and generating outputs P_1 and P_2 that feature short-width pulses. By circuit processing the other output with P_1 and P_2, a pulse is output from V_F when the rotation direction is forward. When the rotation direction is reversed, a pulse is generated from V_R.

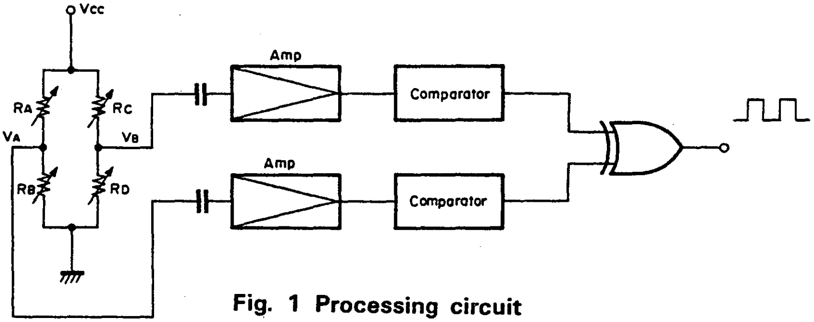


Fig. 1 Processing circuit

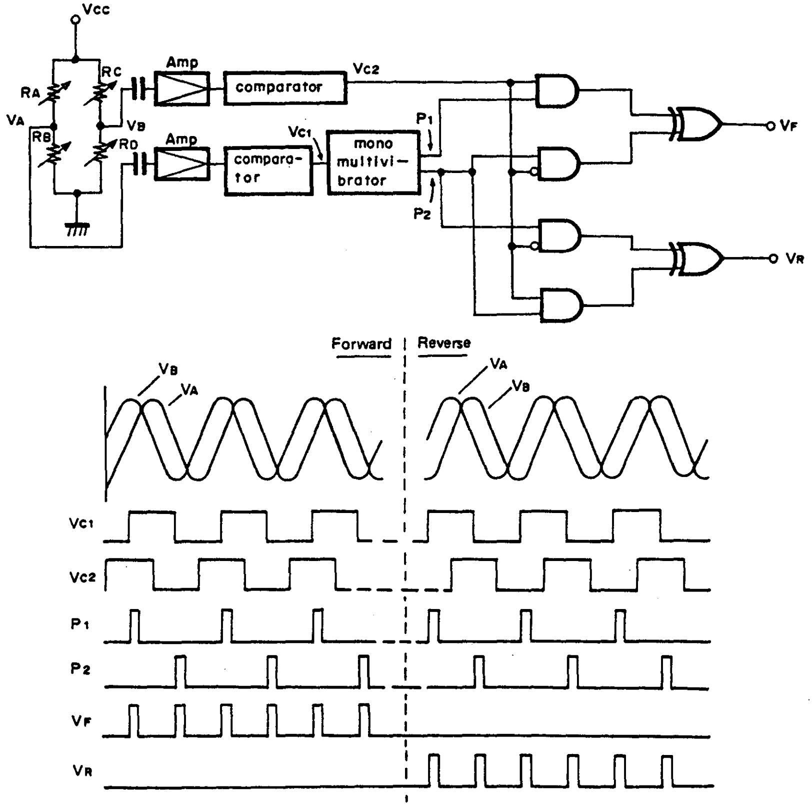


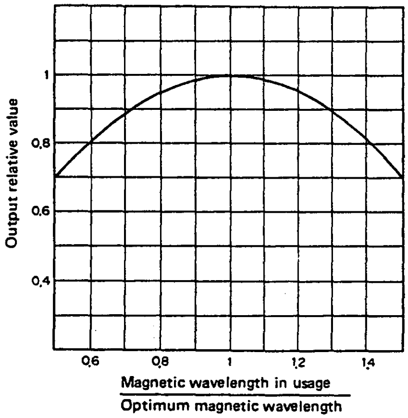
Fig. 2 Forward and reverse rotation detection

7. Allowable range of magnetic wavelength.

Assuming the optimum magnetic wavelength is λ_1 and the magnetic wavelength actually in usage is λ_2: The relation between the output and λ_2/λ_1 is as indicated in Graph 1.
Also, the relation between λ_2/λ_1 and the phase difference, in case of 2-phase output, is indicated in Graph 2.

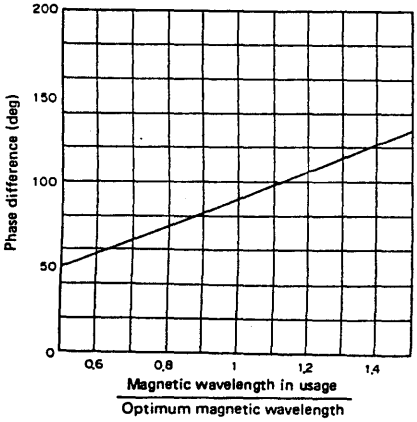
Graph 1

Output relative value vs. $\frac{\text{Magnetic wavelength in usage}}{\text{Optimum magnetic wavelength}}$



Graph 2

Phase difference vs. $\frac{\text{Magnetic wavelength in usage}}{\text{Optimum magnetic wavelength}}$



SONY 8mm Embossed Taping

8mm Embossed Taping for Mini Mold Diodes/Transistors

1. Scope

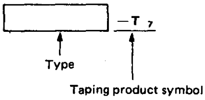
1) This specification describes the taping of Mini-mold Diodes/Transistor as delivered from the Semiconductor Division of Sony Corp.
2) For information other than taping specifications refer to the individual specifications of each product.
   - Absolute maximum rating
   - Electrical characteristics
   - Quality specification
3) The demarcation for Panasert and Sanyo automatic inserters in provided in 5-1 paragraph 2)

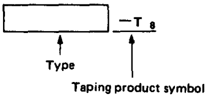
2. Product Identification

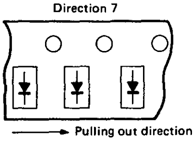
The product name indication is as follows:

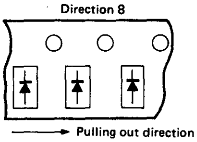
Example

1) Mini mold diode name Indicaiton

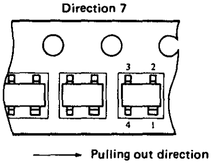


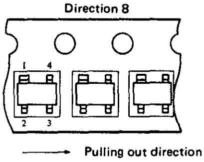






2) Mini mold transistor name Indicaiton





3. Taping Specification

These specifications are based on the stipulations of the Electronic Industries Association of Japan for EIAJ-RC-1009A standards.

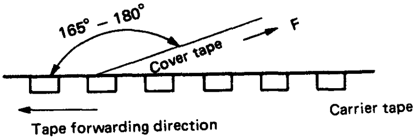
4. Relative Items

1) Percentage of defective packing

Item	Specificaiton	Remarks
Continuous drop in product	0	Within 40 mm of tape with the exclusion of the leader and trailer sections
Inter ent drop Inverse loading Rear loading Wrong product loading	0.2% Max. per reel	Excluding leader and trailer sections

2) Tape strength

(1) Cover tape peel strength 20 to 70g (Opened angle 165° to 180° See Figure below)



(2) Tape bending strength
Bending the tape to a radius of 15 mm should not dislodge products stored in it. Avoid folding the tape.

3) Removing products
(1) Do not let products stick to the cover tape.
(2) Do not let the products flash affect the removal.

4) Tape joint
Do not connect cover tapes and carrier tapes in the reel.

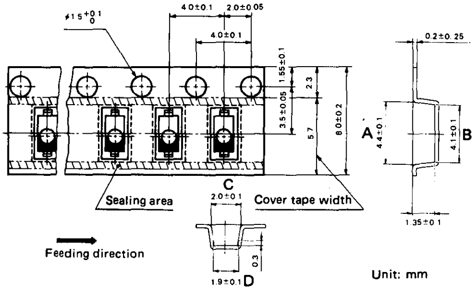
5) Electrical characteristics
The electrical characteristics of chip devices loaded in tapes are stipulated in the respective individual specifications.

6) Storage
Products packed in tapes should be stored in less than 40°C and less than 80% RH humidity. Avoid direct exposure to sun light.

7) Period of guarantee
3 months after delivery.

5. Loading capacity and Rank Demarcation

5-1. Mini mold Diode



Tape dimensions

Cavity Table Unit: mm

Dimention / Name	A	B	C	D
Mini mold Diode	4.4±0.1	4.1±0.1	2.0±0.1	1.9±0.1
Super mini mold Diode	3.0±0.1	2.9±0.1	1.6±0.1	1.5±0.1

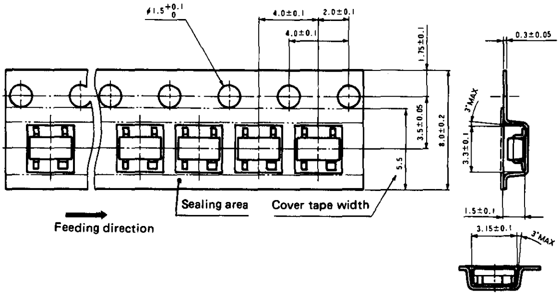
- The R measurement of each corner section is assumed to be R0.25MAX.
- Cumulative error is assumed at ±0.2 mm MAX/10 pitch.
- Total length should be over 1300 mm.

Tape material

Carrier tape (styrene + butadiene) polymer

Cover tape Polyester

5-2. Mini mold Transistor



Tape dimensions Unit: mm

- The R measurement of each corner seciton is assumed to be R0.2MAX.
- Cumulative error is assumed at ±0.2 mm 40 mm/10 pitch.

Number of received

1) A mount should be no more than 3000 pieces/reel.

1) Number of received

A mount should be no more than 3000 pieces/reel.

2)

(1) Loading capacity is kept within 3000 pieces to the reel.

(2) Usage of the Panasert automatic inserter requires: 4 empty spaces for the demarcation of each rank.

Usage of the Sanyo automatic inserter requires: 1 empty space for the demarcation of each rank, plus black tape pasted on the cover tape.

3)

Keep up to 9 ranks per tape.

4)

The minimum figure for 1 rank when less than ΔC 3%: 240+4N PLS. (Where N=0, 1, 2 . . .)

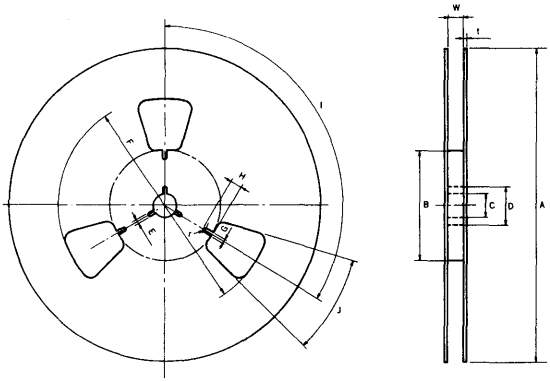
6. Package Indication

Indication on the surface of Reel.

Label indication

TYPE Code No. Lot No. Quantity

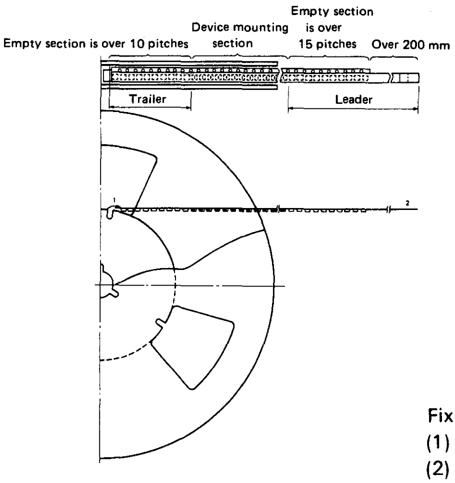
Reel Dimensions



Unit: mm

Symbol	A	B	C	D	E	w	t	r
R10	$\phi 178^{\pm 2.0}$	$\phi 50^{\pm 2.0}$	$\phi 13.0^{\pm 0.5}$	$\phi 21.0^{\pm 1.0}$	2.0±0.5°	$10.0^{+2.0}_{-1.0}$	$2.0^{\pm 0.5}$	1.0
Symbol	F	G	H	I	J			
R10	ϕ120 Min	2	5±1.0	120°	40±5°			

Leader and trailer specifications



Fixing method

(1) Insert the carrier tape tip into the groove.

(2) Secure the tip of the cover tape by winding over an adhesive type.

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Pennsylvania: (East) S.J. Assoc., 609/866-1234
(West) Giesting & Assoc., Inc., 513/385-1105
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	San Diego	Marshall Industries, 619/578-9600
	San Diego	Ryno Electronics, 619/453-8430
	San Francisco	Marshall Industries, 408/943-4600
Colorado:	Denver	Marshall Industries, 303/427-1818
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	Ft. Lauderdale	Reptron, 305/979-8227
	Orlando	Marshall Industries, 305/841-1878
	Tampa	Marshall Industries, 813/576-1399
	Tampa	Reptron, 813/855-4656
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	Norcross	Reptron, 404/446-1300
Illinois:	Chicago	Marshall Industries, 312/490-0155
	Schaumburg	Reptron, 312/882-1700
Indiana:	Indianapolis	Marshall Industries, 317/297-0483
Kansas:	Kansas City	Marshall Industries, 913/492-3121
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	Gaithersburg	Marshall Industries, 301/840-9450
Massachusetts:	Boston	Marshall Industries, 617/658-0810
	Burlington	Western Micro, 617/229-5850
Michigan:	Livonia	Marshall Industries, 313/525-5850
	Livonia	Reptron, 313/525-2700
Minnesota:	Minneapolis	Marshall Industries, 612/559-2211
	Minnetonka	Reptron, 612/938-0000
Missouri:	St. Louis	Marshall Industries, 314/291-4650
New Jersey:	Clifton	Vantage Components, 201/777-4100
	Fairfield	Marshall Industries, 201/882-0320
	Mt. Laurel	Marshall Industries, 609/234-9100
New York:	Binghamton	Marshall Industries, 607/798-1611
	Commack	Vantage Components, 516/543-2000
	Long Island	Marshall Industries, 516/273-2424
	Rochester	Marshall Industries, 716/235-7620
North Carolina:	Raleigh	Marshall Industries, 919/878-9882
Ohio:	Cleveland	Marshall Industries, 216/248-1788
	Columbus	Marshall Industries, 614/891-7580
	Dayton	Marshall Industries, 513/236-8088
	Worthington	Reptron, 614/436-6675
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	Portland	Marshall Industries, 503/644-5050
Pennsylvania	Philadelphia	Marshall Industries, 609/234-9100
	Pittsburgh	Marshall Industries, 412/963-0441
Texas:	Austin	Marshall Industries, 512/837-1991
	Brownsville	Marshall Industries, 512/542-4589
	Dallas	Marshall Industries, 214/233-5200
	El Paso	Marshall Industries, 915/593-0706
	Houston	Marshall Industries, 713/895-9200
Utah:	Salt Lake City	Marshall Industries, 801/261-0901
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