

## RF AMP FOR CDP

The KA9201, which is the RF amplifier, is a monolithic integrated circuit designed for three-spot type optical pick-up of the compact disc player.

It consists of a RF signal processing circuit, Focus Error AMP, Tracking Error AMP, Focus OK Detector, Mirror Detector, Defect Detector, EFM Comparator and automatic power controller for laser diode.

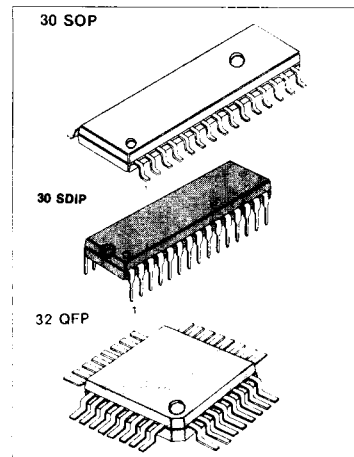
## FEATURES

- Functions: RF AMP
  - Focus Error AMP
  - Tracking Error AMP
  - Focus OK Detector
  - Mirror Detector
  - Defect Detector
  - EFM (Eight to Fourteen Modulation) Comparator
  - Automatic Asymmetry Control AMP
  - Center Voltage Buffer
  - APC (Automatic Power Control) AMP for Photo-Diode and Laser-Diode drive

- Single power supply operation (+5V) as well as split power supply operation ( $\pm 5V$ )
- Low power consumption (100mW at  $\pm 5V$ , 50mW at +5V)
- Built-in automatic power controller use for P-sub and N-sub of the laser diode
- Minimum number of external components required
- Built-in disc defect detection circuit for improvement to play ability
- Recommend operation supply voltage range:  $V_{CC}-V_{EE}$ : 3.4 ~ 11V  
 $V_{CC}-D_{GND}$ : 3.4 ~ 5.5V

- Power Supply Condition:

	$V_{CC}$	$V_{EE}$	$V_C$	$V_R (V_{rel})$	$D_{GND}$
Single Power Supply	Power Supply	GND	$V_R$	VC	GND
Split Power Supply	+ Power Supply	- Power Supply	$D_{GND}$	No Connecting	GND



## ORDERING INFORMATION

Device	Package	Operating Temperature
KA9201M	30 SDIP	- 25°C ~ + 75°C
KA9201D	30 SOP	
KA9201Q	32 QFP	

BLOCK DIAGRAM

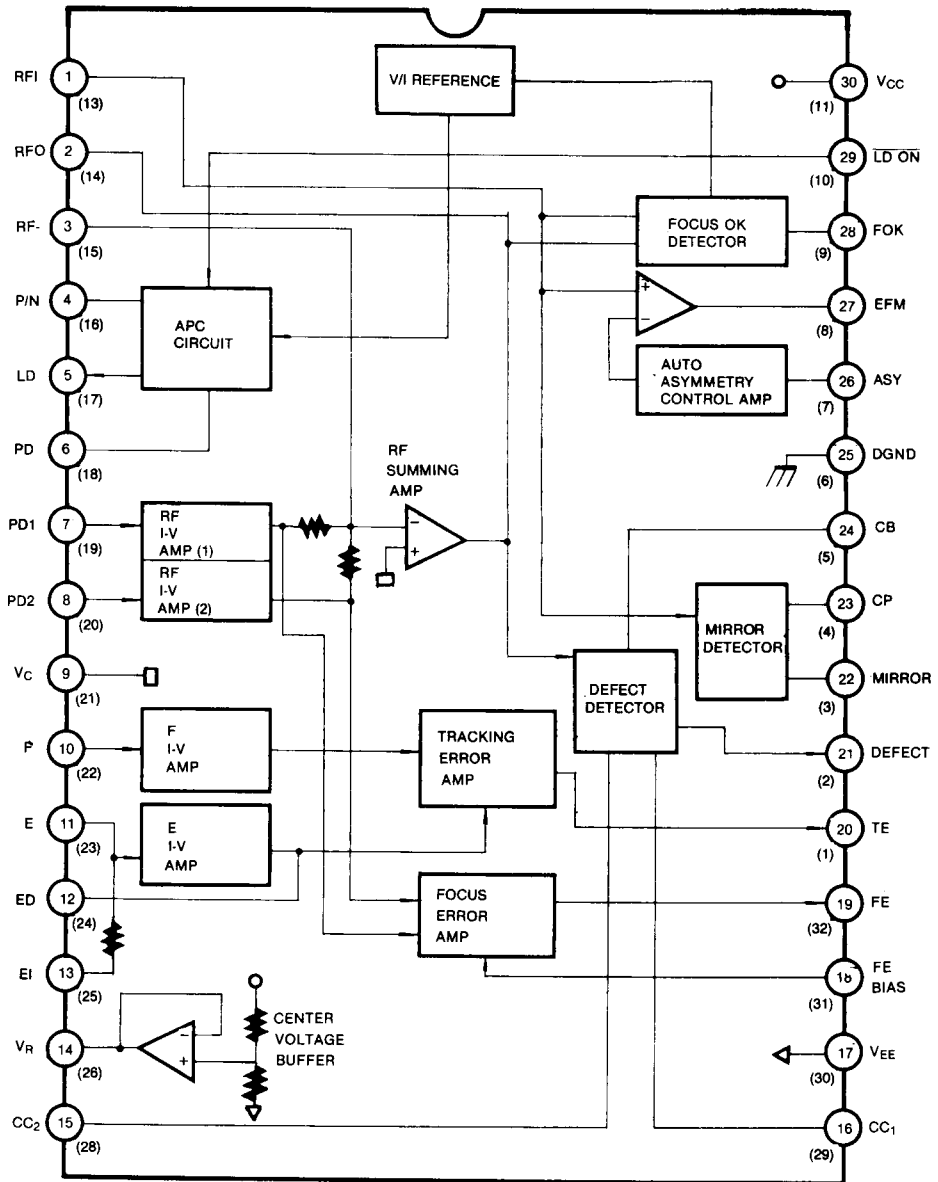


Fig. 1

· PIN12, 27 of 32 QFP is NC

\* The number of ( ) is the TYPE of 32 QFP

**ABSOLUTE MAXIMUM RATINGS** ( $T_a = 25^\circ\text{C}$ )

Characteristic	Symbol	Value	Unit
Supply Voltage	$V_{CC} - V_{EE}$	12	V
Power Dissipation	$P_D$	800	mW
Operating Temperature	$T_{OPR}$	- 25 ~ + 75	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	- 55 ~ + 150	$^\circ\text{C}$

**ELECTRICAL CHARACTERISTICS**

( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 2.5\text{V}$ ,  $V_{EE} = D_{GND} = -2.5\text{V}$ ,  $V_C = \text{GND}$ , unless otherwise specified)

Stage	No	Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Circuit Current	1	$V_{CC}$ Current	$I_{CC}$	DC Current	8.0	11.4	15.5	mA
	2	$V_{EE}$ Current	$I_{EE}$		- 15.0	- 11.0	- 7.5	mA
	3	$D_{GND}$ Current	$I_D (\text{GND})$		- 1.1	- 0.85	- 0.6	mA
RF AMP	4	Input Offset Voltage	$V_{IO1}$	DC voltage	- 50	0	50	mV
	5	Voltage Gain	$G_{V1}$	$V_i = 2\text{KHz}$ , 40mV sinewave, Output; sinewave	25.1	28.1	31.1	dB
	6	Maximum Output Amplitude	$V_{O(\text{MAX})1}$	$V_i = 0.2\text{V}$ DC Output; + peak voltage	1.3			V
	7	Maximum Output Amplitude	$V_{O(\text{MAX})2}$	$V_i = -0.2\text{V}$ DC Output; - peak voltage			- 0.3	V
Focus Error AMP	8	Input Offset Voltage	$V_{IO2}$	DC voltage	- 20		120	mV
	9	Voltage Gain	$G_{V2}$	$V_i = 1\text{KHz}$ , 32mV sinewave, Output; sinewave	27	30	33	dB
	10	Voltage Gain	$G_{V3}$		27	30	33	dB
	11	Gain Difference	$\Delta G_{V1}$		- 3	0	3	dB
	12	Maximum Output Amplitude H	$V_{OH(\text{MAX})1}$	$V_i = -0.2\text{V}$ DC Output; - peak voltage	1.9			V
	13	Maximum Output Amplitude L	$V_{OL(\text{MAX})1}$	$V_i = 0.2\text{V}$ DC Output; - peak voltage			- 1.9	V
Tracking Error AMP	14	Input Offset Voltage	$V_{IO3}$	DC voltage	- 50		50	mV
	15	Voltage Gain F	$G_{V4}$	$V_i = 1\text{KHz}$ , 0.3V sinewave, input to output ratio Output; sinewave	7	10	13	dB
	16	Voltage Gain E	$G_{V5}$		7	10	13	dB
	17	Gain Difference	$\Delta G_{V2}$		- 3	0	3	dB
	18	Maximum Output Amplitude H	$V_{OH(\text{MAX})2}$	$V_i = 2.0\text{V}$ DC Output; + peak voltage	1.9			V
	19	Maximum Output Amplitude L	$V_{OL(\text{MAX})2}$	$V_i = -2.0\text{V}$ DC Output; - peak voltage			- 1.9	V

## ELECTRICAL CHARACTERISTICS (Continued)

Stage	No	Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
APC AMP	20	Output Voltage 1	$V_{O1}$	$V_i = 190\text{mV DC}$	1.4			V
	21	Output Voltage 2	$V_{O2}$	$V_i = 90\text{mV DC}$			-1.4	V
	22	Output Voltage 3	$V_{O3}$	$V_i = 100\text{mV DC}$	1.4			V
	23	Output Voltage 4	$V_{O4}$	$V_i = 170\text{mV DC}$			-1.4	V
	24	Output Voltage 5	$V_{O5}$	$V_i = 0\text{V DC}$	1.4			V
	25	Output Voltage 6	$V_{O6}$	$V_i = 0\text{V DC}$			-1.4	V
	26	Maximum Output Amplitude H	$V_{OH(MAX)3}$	$V_a = 0\text{V}$ , $I_a = -0.8\text{mA}$ Output; + peak voltage	0			V
27	Maximum Output Amplitude L	$V_{OL(MAX)3}$	$V_a = 0.6\text{V}$ , $I_a = 0.8\text{mA}$ Output; - peak voltage			0	V	
Focus OK	28	Threshold Voltage	$V_{TH1}$	$V_i = \text{output } (V_{CC} + D_{GND})/2$ must be adjusted by the DC voltage across RFI and RFO	-430	-390	-350	mV
	29	High Output Voltage	$V_{OH(FOK)1}$	Input across RFI and RFO 1V, 375mV/(DC) sinewave, Output; pulse	2.2			V
	30	Low Output Voltage	$V_{OL(FOK)1}$				1.8	V
31	Maximum Operating Frequency	$f_{(MAX)}$	45				KHz	
Mirror AMP	32	High Output Voltage	$V_{OH(MIR)1}$	$V_i = 10\text{KHz } 0.8\text{V}$ , $-0.4\text{V(DC)}$ sinewave, Output; pulse	1.8			V
	33	Low Output Voltage	$V_{OL(MIR)1}$				-2.2	V
	34	Mirror Hold Frequency Response	$f_{RES(M)}$	$V_i = 0.8\text{V}$ , $0.2\text{V(DC)}$ , $f(\text{carrier}) = 500\text{KHz}$ AM modulation Output; pulse		400	600	Hz
	35	Bottom Hold Frequency Response	$f_{RES(B)}$	$V_i = 0.8\text{V}$ , $0.4\text{V(DC)}$ sinewave, Output; pulse		500	900	Hz
	36	Maximum Input Operating Frequency	$f_{i(MAX)1}$		30	70		KHz
	37	Minimum Input Voltage	$V_{i(MIN)1}$	$V_i = 10\text{KHz}$ , $0.4\text{V(DC)}$ sinewave, Output; pulse		0.1	0.2	V
38	Maximum Input Voltage	$V_{i(MAX)1}$	1.8				V	
Defect AMP	39	High Output Voltage	$V_{OH(DEF)1}$	$V_i = 32\text{mV}$ , $+15\text{mV(DC)}$ sinewave, Output; pulse	1.8			V
	40	Low Output Voltage	$V_{OL(DEF)1}$				-2.2	V

## ELECTRICAL CHARACTERISTICS (Continued)

Stage	No	Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Defect AMP	41	Minimum Input Operating Frequency	$f_{i(MIN)2}$	$V_i = 32mV, +15mV(DC)$ sinewave, Output; pulse		670	1000	Hz
	42	Maximum Input Operating Frequency	$f_{i(MAX)2}$		2.0	4.7		KHz
	43	Minimum Input Voltage	$V_{i(MIN)2}$	$V_i = 50Hz, 15mV(DC)$ pulsewave, symmetry; 95% Output; pulse		0.3	0.5	V
	44	Maximum Input Voltage	$V_{i(MAX)2}$		1.8			V
EFM Comparator	45	Duty Cycle 1	$D_1$	$V_i = 750KHz, 0.7V$ sinewave, Output; DC voltage	-50	0	50	mV
	46	Duty Cycle 2	$D_2$	$V_i = 750KHz, 0.7V, +0.25V(DC)$ sinewave Output; DC voltage	0	50	100	mV
	47	High Output Voltage	$V_{OH(EFM)1}$	$V_i = 750KHz, 0.7V$ sinewave Output; pulse	1.2			V
	48	Low Output Voltage	$V_{OL(EFM)1}$				-1.2	V
	49	Minimum Input Voltage	$V_{i(MIN)3}$	$V_i = 750KHz$ sinewave Output; pulse			0.12	V
	50	Maximum Input Voltage	$V_{i(MAX)3}$		1.8			V
51	Maximum Input Operating Frequency	$f_{i(MAX)3}$	$V_i = 750KHz, 0.7V$ sinewave, Output; pulse	4.0			MHz	
Center Voltage Buffer	52	Input Offset Voltage	$V_{IO4}$	DC voltage	-100	0	100	mV
	53	Maximum Output Current (+)	$I_{O+(MAX)}$		5			mA
	54	Maximum Output Current (-)	$I_{O-(MAX)}$				-5	mA
(Ta = 25°C, V <sub>CC</sub> = 5.0V, V <sub>EE</sub> = -5.0V, D <sub>GND</sub> = VC = GND, unless otherwise specified)								
RF AMP	55	Maximum Output Amplitude (H)	$V_{OH(MAX)4}$	$V_i = 0.2V$ DC Output; DC voltage	3.5			V
	56	Maximum Output Amplitude (L)	$V_{OL(MAX)4}$	$V_i = -0.2V$ DC Output; DC voltage			0.3	V
Focus Error AMP	57	Maximum Output Amplitude (H)	$V_{OH(MAX)5}$	$V_i = -0.2V$ DC Output; DC voltage	4.2			V
	58	Maximum Output Amplitude (L)	$V_{OL(MAX)5}$	$V_i = 0.2V$ DC Output; DC voltage			-2.2	V
Tracking Error AMP	59	Maximum Output Amplitude (H)	$V_{OH(MAX)6}$	$V_i = 2.0V$ DC Output; DC voltage	4.2			V
	60	Maximum Output Amplitude (L)	$V_{OL(MAX)6}$	$V_i = -2.0V$ DC Output; DC voltage			-2.2	V

## ELECTRICAL CHARACTERISTICS (Continued)

Stage	No	Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
APC AMP	61	Output Voltage 7	$V_{O7}$	$V_i = 190\text{mV DC}$ Output DC voltage	1.4			V
	62	Output Voltage 8	$V_{O8}$	$V_i = 90\text{mV DC}$ Output DC voltage			-1.4	V
	63	Output Voltage 9	$V_{O9}$	$V_i = 100\text{mV DC}$ Output DC voltage	1.4			V
	64	Output voltage 10	$V_{O10}$	$V_i = 170\text{mV DC}$ Output DC voltage			-1.4	V
	65	Output Voltage 11	$V_{O11}$	$V_i = 0\text{V DC}$ Output DC voltage	3.8			V
	66	Output Voltage 12	$V_{O12}$	$V_i = 190\text{mV DC}$ Output DC voltage			-3.8	V
	67	Maximum Output Amplitude H	$V_{OH(MAX)7}$	$V_a = 0\text{V DC}$ , $I_a = -0.8\text{mA}$ Output; DC voltage	2.5			V
	68	Maximum Output Amplitude L	$V_{OL(MAX)7}$	$V_a = 0.6\text{V DC}$ , $I_a = 0.8\text{mA}$ Output; DC voltage			-2.5	V
Focus OK AMP	69	Threshold Voltage	$V_{TH2}$	Input DC voltage; output ( $V_{CC} + D_{GND}$ )/2 must be adjusted by the DC voltage across RFI And RFO	-430	-390	-350	mV
	70	High Output Voltage	$V_{OH(FOK)2}$	$V_i = 1\text{V}$ , $-375\text{mV(DC)}$ across RFI and RFO; sinewave, Output; pulse	4.7			V
	71	Low Output Voltage	$V_{OL(FOK)2}$				0.7	V
Mirror AMP	72	High Output Voltage	$V_{OH(MIR)2}$	$V_i = 10\text{KHz } 0.8\text{V}$ , $-0.4\text{V(DC)}$ sinewave, Output; pulse	4.3			V
	73	Low Output Voltage	$V_{OL(MIR)2}$				0.3	V
Defect AMP	74	High Output Voltage	$V_{OH(DEF)2}$	$V_i = 1\text{KHz } 32\text{mV}$ , $+15\text{mV(DC)}$ sinewave, Output; pulse	4.3			V
	75	Low Output Voltage	$V_{OL(DEF)2}$				-0.3	V
EFM Comparator	76	Duty 3	$D_3$	$V_i = 750\text{KHz } 0.7\text{V}$ sinewave Output; DC voltage	2.45	2.50	2.55	V
	77	Duty 4	$D_4$	$V_i = 750\text{KHz } 0.7\text{V}$ , $+0.25\text{V(DC)}$ sinewave Output; pulse	2.50	2.55	2.60	V
	78	High Output Voltage	$V_{OH(EFM)2}$	$V_i = 750\text{KHz } 0.7\text{V}$ , sinewave, Output; pulse	3.7			V
	79	Low Output Voltage	$V_{OL(EFM)2}$				1.3	V

TEST CIRCUIT

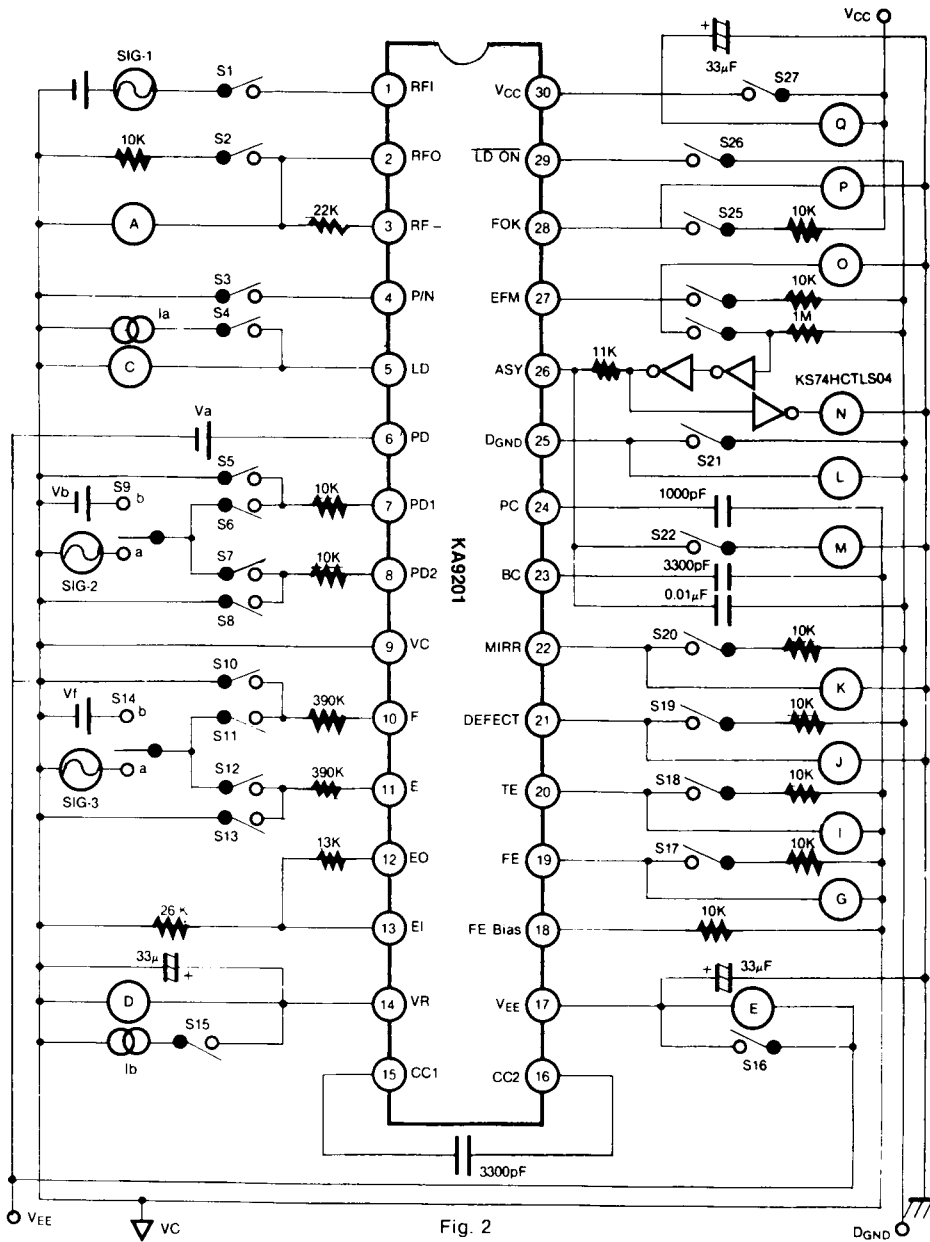


Fig. 2

\*) Note: KS74HCTLS04: Supply Voltage = 5V

**TEST METHODE (SWITCH CONDITION)** ( $V_{CC} = 2.5V, V_{EE} = D_{GND} = -2.5V, V_C = GND$ )

Stage	No	Characteristic	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	Input	Test Point
Circuit Current	1	I <sub>CC</sub>			ON													ON	ON	ON	ON	ON					ON	ON			Q
	2	I <sub>EE</sub>			ON													ON	ON	ON	ON	ON					ON	ON			E
	3	I <sub>0 (GND)</sub>																ON	ON	ON	ON	ON					ON	ON			L
	4	V <sub>CE1</sub>			ON													ON	ON	ON	ON	ON					ON	ON			A
RF AMP	5	G <sub>V1</sub>					ON	ON									ON	ON	ON	ON	ON						ON	ON	SIG-2		A
	6	V <sub>O1 (MAX) 1</sub>		ON			ON	ON		b							ON	ON	ON	ON	ON						ON	ON	V <sub>6</sub>		A
	7	V <sub>O1 (MAX) 2</sub>		ON			ON	ON		b							ON	ON	ON	ON	ON						ON	ON	V <sub>6</sub>		A
	8	V <sub>O2</sub>						ON	ON		a						ON	ON	ON	ON	ON						ON	ON	SIG-2		G
Focus Error AMP	9	G <sub>O2</sub>					ON	ON		a							ON	ON	ON	ON	ON						ON	ON	SIG-2		G
	10	G <sub>O3</sub>				ON				a							ON	ON	ON	ON	ON						ON	ON	SIG-2		G
	11	ΔG <sub>V1</sub>																ON	ON	ON	ON						ON	ON			G
	12	V <sub>OH (MAX) 1</sub>					ON	ON		b							ON	ON	ON	ON	ON						ON	ON	V <sub>6</sub>		G
Tracking Error AMP	13	V <sub>OL (MAX) 1</sub>					ON	ON		b							ON	ON	ON	ON	ON						ON	ON	V <sub>6</sub>		G
	14	V <sub>O3</sub>			ON												ON	ON	ON	ON	ON						ON	ON			I
	15	G <sub>V4</sub>									ON		ON	ON	a		ON	ON	ON	ON	ON						ON	ON	SIG-3		I
	16	G <sub>V5</sub>									ON		ON	ON	a		ON	ON	ON	ON	ON						ON	ON	SIG-3		I
APC AMP	17	ΔG <sub>V2</sub>																ON	ON	ON	ON						ON	ON			I
	18	V <sub>OH (MAX) 2</sub>						ON	ON				ON	ON	b		ON	ON	ON	ON	ON						ON	ON	V <sub>1</sub>		I
	19	V <sub>OL (MAX) 2</sub>						ON	ON				ON	ON	b		ON	ON	ON	ON	ON						ON	ON	V <sub>1</sub>		I
	20	V <sub>O1</sub>						ON	ON								ON	ON	ON	ON	ON						ON	ON	Va		C
Focus OK AMP	21	V <sub>O2</sub>															ON	ON	ON	ON	ON						ON	ON	Va		C
	22	V <sub>O3</sub>															ON	ON	ON	ON	ON						ON	ON	Va		C
	23	V <sub>O4</sub>															ON	ON	ON	ON	ON						ON	ON	Va		C
	24	V <sub>O5</sub>															ON	ON	ON	ON	ON						ON	ON	Va		C
Mirror AMP	25	V <sub>O6</sub>															ON	ON	ON	ON	ON						ON	ON	Va		C
	26	V <sub>OH (MAX) 3</sub>															ON	ON	ON	ON	ON						ON	ON	Va, Ia		C
	27	V <sub>OL (MAX) 3</sub>															ON	ON	ON	ON	ON						ON	ON	Va, Ia		C
	28	V <sub>FH1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		P
Focus Error AMP	29	V <sub>OH (FOK) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		P
	30	V <sub>OL (FOK) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		P
	31	f <sub>1 (MAX)</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		P
	32	V <sub>OH (MIR) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
Focus Error AMP	33	V <sub>OL (MIR) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
	34	f <sub>RES (M)</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
	35	f <sub>RES (B)</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
	36	f <sub>1 (MAX) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
Focus Error AMP	37	f <sub>1 (MIN) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K
	38	V <sub>1 (MAX) 1</sub>															ON	ON	ON	ON	ON						ON	ON	SIG-1		K



TEST METHODE (SWITCH CONDITION) (Continued)

Stage	No	Characteristic	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	Input	Test Point	
Defect AMP	39	V <sub>OH</sub> (DEF)1					ON	ON			a					ON					ON								ON	SIG-2	J	
	40	V <sub>OL</sub> (DEF)1					ON	ON			a					ON					ON								ON	SIG-2	J	
	41	f <sub>T</sub> (MIN)2					ON	ON			a					ON					ON								ON	SIG-2	J	
	42	f <sub>T</sub> (MAX)2					ON	ON			a					ON					ON								ON	SIG-2	J	
	43	V <sub>I</sub> (MIN)2					ON	ON			a					ON					ON								ON	SIG-2	J	
EFM Comparator	44	V <sub>I</sub> (MAX)2					ON	ON			a					ON				ON									ON	SIG-2	J	
	45	D <sub>1</sub>	ON		ON																			ON	ON				ON	SIG-1	M	
	46	D <sub>2</sub>	ON		ON																			ON	ON				ON	SIG-1	M	
	47	V <sub>OH</sub> (EFM)1	ON		ON																			ON	ON				ON	SIG-1	O	
Center Voltage Buffer	48	V <sub>OL</sub> (EFM)1	ON		ON																			ON	ON				ON	SIG-1	O	
	49	V <sub>I</sub> (MIN)3	ON		ON																			ON	ON				ON	SIG-1	N	
	50	V <sub>I</sub> (MAX)3	ON		ON																			ON	ON				ON	SIG-1	N	
	51	f <sub>T</sub> (MAX)3	ON		ON																			ON	ON				ON	SIG-1	N	
	52	V <sub>OL</sub>			ON																			ON	ON				ON	-	D	
Center Voltage Buffer	53	I <sub>Q</sub> (-MAX)			ON																			ON	ON				ON	lb	D	
	54	I <sub>Q</sub> (-MAX)			ON																			ON	ON				ON	lb	D	
(V <sub>CC</sub> =5.0V, V <sub>EE</sub> = -5.0V, D <sub>REF</sub> =V <sub>C</sub> =GND)																																
RF AMP	55	V <sub>OH</sub> (MAX)4			ON						b																		ON	Vb	A	
	56	V <sub>OL</sub> (MAX)4			ON						b																		ON	Vb	A	
Focus Error AMP	57	V <sub>OH</sub> (MAX)5					ON	ON			b																		ON	Vb	G	
	58	V <sub>OL</sub> (MAX)5					ON	ON			b																		ON	Vb	G	
Tracking Error AMP	59	V <sub>OH</sub> (MAX)6										ON				ON	b												ON	Vl	I	
	60	V <sub>OL</sub> (MAX)6										ON				ON	b												ON	Vl	I	
APC AMP	61	V <sub>OP</sub>																											ON	Va	C	
	62	V <sub>OE</sub>																											ON	Va	C	
	63	V <sub>OE</sub>																											ON	Va	C	
	64	V <sub>OP</sub>																											ON	Va	C	
	65	V <sub>OP</sub>																											ON	Va	C	
	66	V <sub>OP</sub>																											ON	Va	C	
	67	V <sub>OH</sub> (MAX)7																											ON	Va	C	
	68	V <sub>OL</sub> (MAX)7																											ON	Va	C	
	69	V <sub>TH</sub>																											ON	Va	la	C
	70	V <sub>OH</sub> (FOK)2	ON																										ON	Va	la	C
Focus OK AMP	71	V <sub>OL</sub> (FOK)2	ON																										ON	SIG-1	P	
	72	V <sub>OH</sub> (MR)2	ON																										ON	SIG-1	P	
Mirror AMP	73	V <sub>OL</sub> (MR)2	ON																										ON	SIG-1	P	
	74	V <sub>OL</sub> (MR)2	ON																										ON	SIG-1	P	
Defect AMP	75	V <sub>OH</sub> (DEF)2									a																		ON	SIG-1	K	
	76	D <sub>3</sub>									a																		ON	SIG-2	J	
EFM Comparator	77	D <sub>4</sub>	ON		ON																								ON	SIG-2	J	
	78	V <sub>OH</sub> (EFM)2	ON		ON																								ON	SIG-1	M	
	79	V <sub>OL</sub> (EFM)2	ON		ON																								ON	SIG-1	M	

APPLICATION CIRCUIT

1) +5V Single Power Supply for P-sub Laser Diode

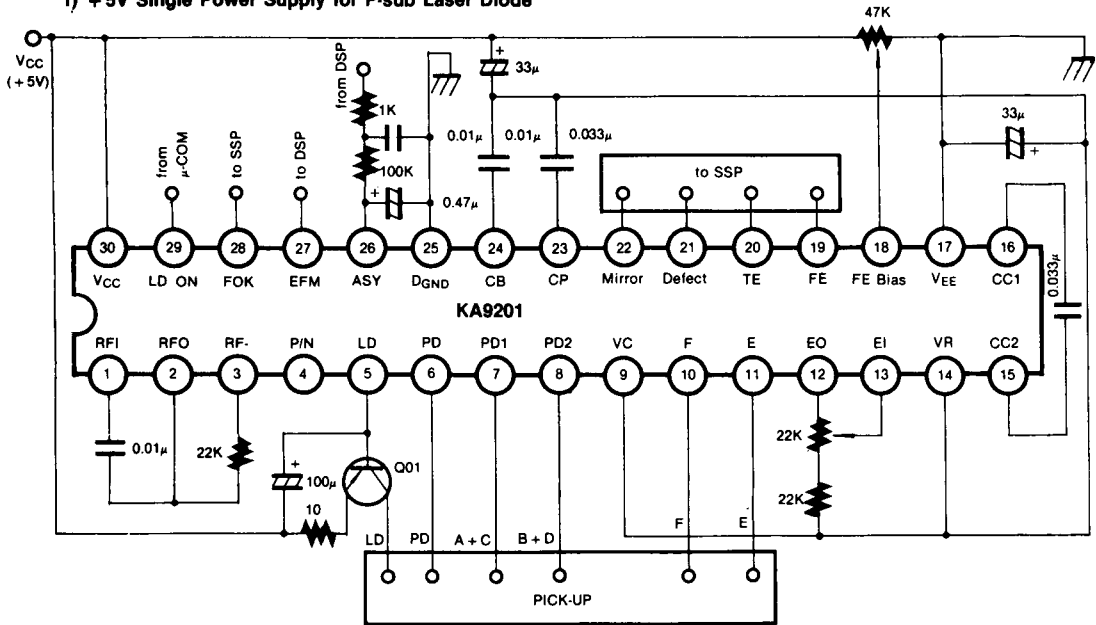


Fig. 3

2) +5V Single Power Supply for N-sub Laser Diode

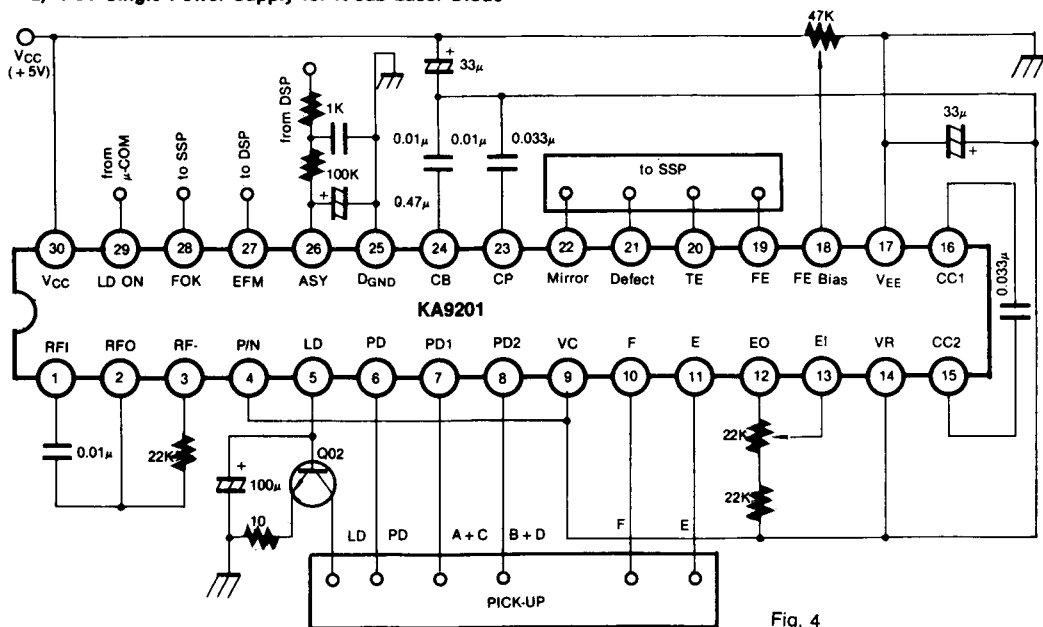


Fig. 4

APPLICATION CIRCUIT

3)  $\pm 5V$  Split Power Supply for P-sub Laser Diode

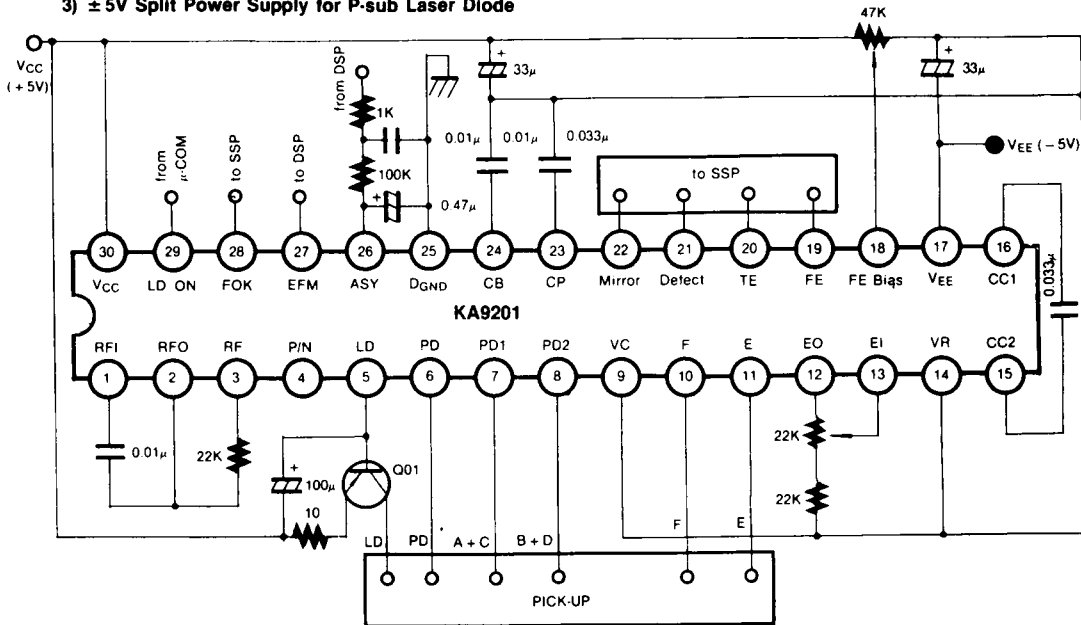


Fig. 5

4)  $\pm 5V$  Split Power Supply for N-sub Laser Diode

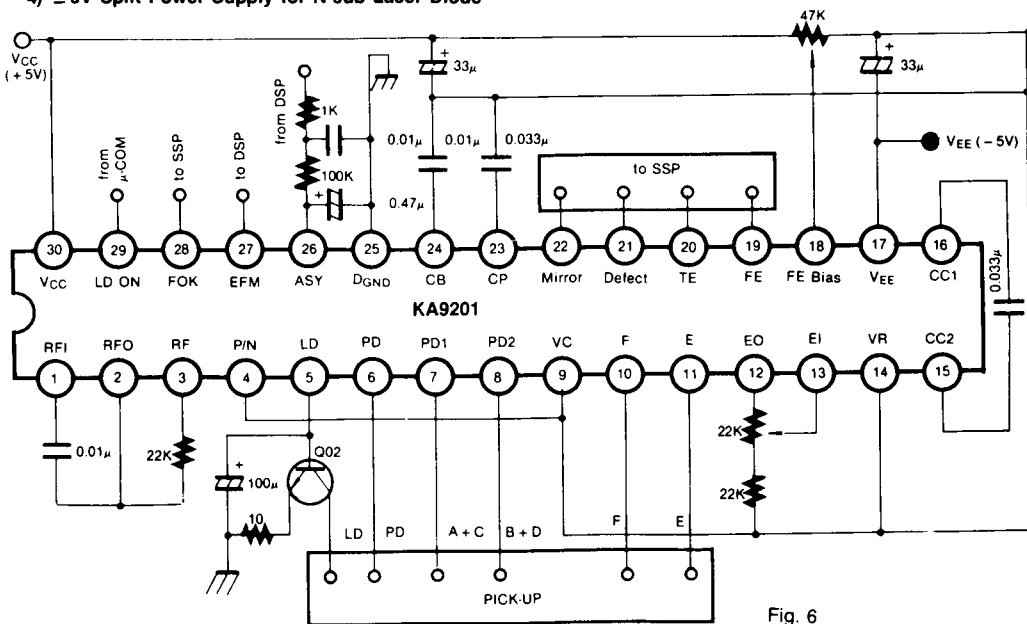


Fig. 6