BA9211
BA9211F

Digital-to-analog converter, 10 bit

The BA9211 and BA9211F are 10-bit D/A converters with a built-in reference voltage supply.

The reference voltage supply circuit is an independent block and it can use an external reference power supply.

These ICs have a very fast conversion time. They are for use on machines with a digital-to-analog control system.

Features

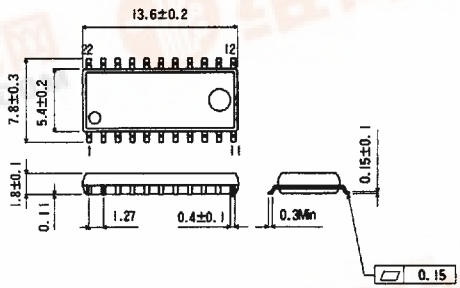
- available in DIP22 and SOP22 packages
- setting speed is as low as 250 ns
- built in reference supply voltage
- can be used for multiplying

Applications

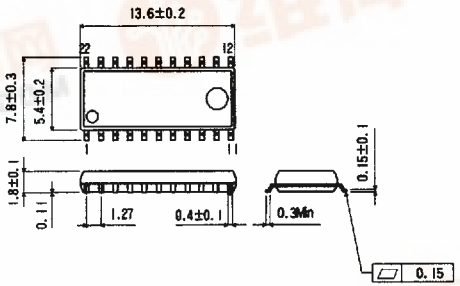
- programmable gain amplifiers
- programmable attenuators
- electrical musical instruments
- signal generators
- servo controllers
- digitally controlled power supply

Dimensions (Units : mm)

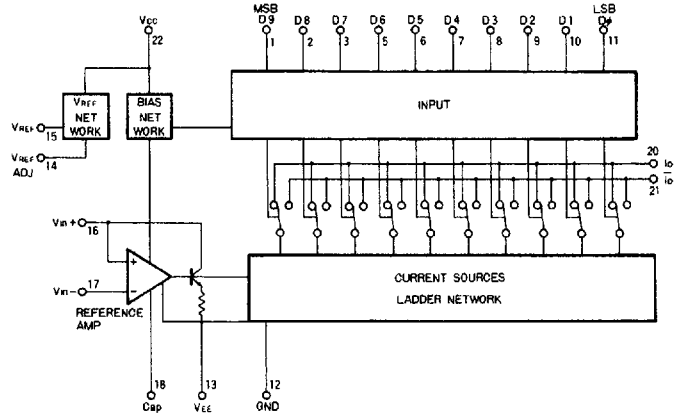
BA9211 (DIP22)



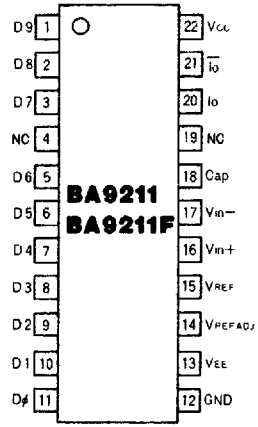
BA9211F (SOP22)



Block diagram



Pin connections



Absolute maximum ratings (T_a = 25°C)

Parameter		Symbol	Limits	Unit	Conditions
Power supply voltage		V_{CC} V_{EE}	+5.5 −15	V	
Power dissipation	BA9211	P_d	600	mW	Reduce power by 6 mW/°C for each degree above 25°C.
	BA9211F		1650		Mounted on 65 × 50 × 1 mm alumina substrate. 550 mm when unmounted. See power dissipation curve.
Ref voltage V16, V17		V_{16}, V_{17}	V_{EE} ~ V_{CC}	V	
Logic input pin		V_{IN}	−5 ~ V_{CC}	V	
Operational temperature		T_{opr}	−20 ~ +70	°C	
Storage temperature		T_{stg}	−55 ~ +125	°C	

Electrical characteristics (T_a = 25°C, V_{CC} = +5 V, V_{EE} = -12 V)

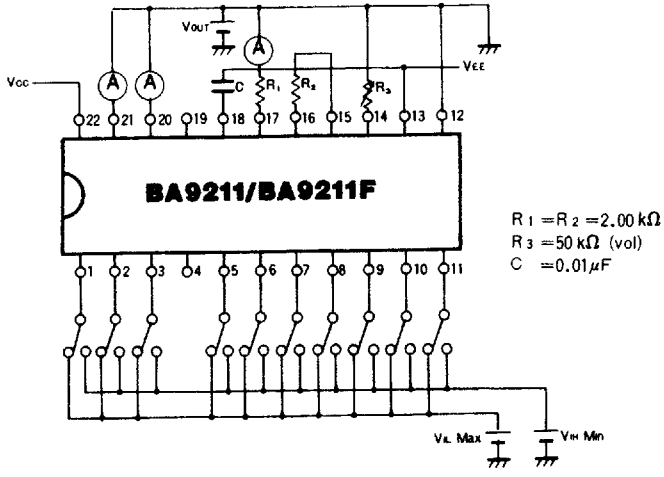
Parameter	Symbol	Min	Typical	Max	Unit	Conditions	Test fig
Resolving power		10	10	10	bit		
Monotonicity		10	10	10	bit		
Differential nonlinearity	DNL	10			bit		1
Nonlinearity	NL			±0.05	%FS		1
Full scale current	I_{FS}		3.996		mA		1
Current-to-temperature coefficient, full scale	TCI_{FS}		±50		ppm/°C		
Current asymmetry, full scale	I_{FSS}			±2.0	µA	$I_{FSS} = I_{FS} - \overline{I_{FS}}$	1
Zero scale current	I_{ZS}			0.1	µA		1
Setting time	t_S		250		ns		4
High level input voltage	V_{IH}	2.0			V		6
Low level input voltage	V_{IL}			0.8	V		6
Logic input current	I_{IN}			70	µA		6
Reference power supply voltage	V_{REF}		1.95	2.24	V		3
Ref voltage-to-temperature characteristics	TCV_{REF}		±50		ppm/°C		
Reference input current	I_{REF}	0.2	1.0	1.1	mA		2
Reference input bias current	I_{17}		−0.5	−2.0	µA		1
Reference input slew rate	dI/dt	4.0	8.0		mA/µs	C = 0 pF	5
Power supply voltage dependance	P_{SS}+			±0.001	%FS/%	V_{CC} = 4.75 ~ 5.25 V, V_{EE} = −12 V	1
Power supply voltage independence	P_{SS}-			±0.001	%FS/%	V_{CC} = 5.0 V, V_{EE} = −11 ~ −15 V	1
Power supply voltage	V_{CC}	4.75	5.0	5.25	V	V_{OUT} = 0 V	
	V_{EE}	−10.8	−12.0	−13.2	V	V_{OUT} = 0 V	
Operating current	I_{CC}		13.0	17.0	mA	V_{CC} = 5 V, V_{EE} = −12 V	7
	I_{EE}		−16.0	−23.0	mA	V_{CC} = 5 V, V_{EE} = −12 V	
Power dissipation	P_d		257	393		V_{CC} = 5 V, V_{EE} = −12 V	7
Noise factor	N_{FS}		0.2	1	mV_{rms}	R = 1 kΩ	

Code formats

Data input	Analog output
MSB **LSB**	**V_O (V)**
0 1 1 1 1 1 1 1 1 1 1	9.980
0 1 1 1 1 1 1 1 1 1 0	9.960
0 0 0 0 0 0 0 0 0 0 1	0.020
0 0 0 0 0 0 0 0 0 0 0	0.000
1 1 1 1 1 1 1 1 1 1 1	–0.020
1 0 0 0 0 0 0 0 0 0 1	–9.980
1 0 0 0 0 0 0 0 0 0 0	–10.000

Test circuits

Figure 1 DNL, NL, I_{FS}, I_{FSS}, I_{ZS}, P_{SS+}, and P_{SS-} test circuit



Differential Nonlinearity (DNL.) and Nonlinearity (NL) definitions:

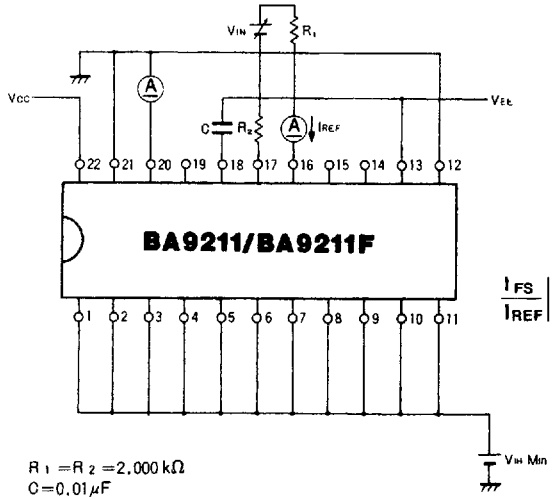
I_{LSB} output current is defined as follows:

$LSB = (I_{FS} - I_{ZS})/1023$
$I_{FS} = I_O\ (1023)$
$I_{ZS} = I_O\ (0)$

$DNL = (I_O(N) - I_O(N-1))/LSB$
$N = 1 \sim 1023$ (N is input data)

$NL = (I_O(N) - (N \times LSB + I_{ZS}))100/I_{FS}$ (%FS)
$N = 1 \sim 1023$

Figure 2 I_{REF} test circuit



$$\frac{I_{FS}}{I_{REF}}\Big|_{I_{REF}=1mA} \quad -0.01 < \frac{I_{FS}}{I_{REF}} < \frac{I_{FS}}{I_{REF}}\Big|_{I_{REF}=1mA} \quad +0.01$$

Figure 3 V_{REF} test circuit

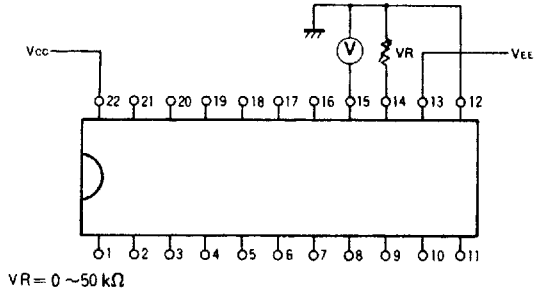


Figure 4 Setting time test circuit

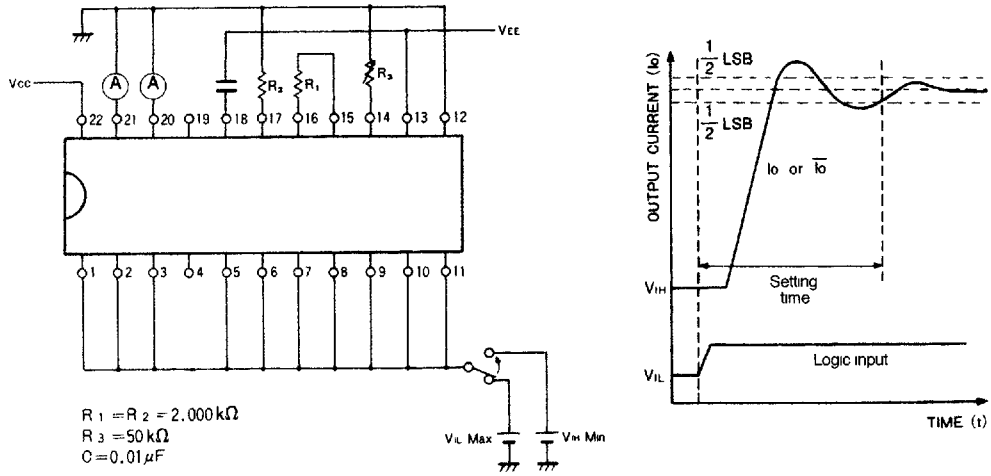


Figure 5 Reference power supply input test circuit

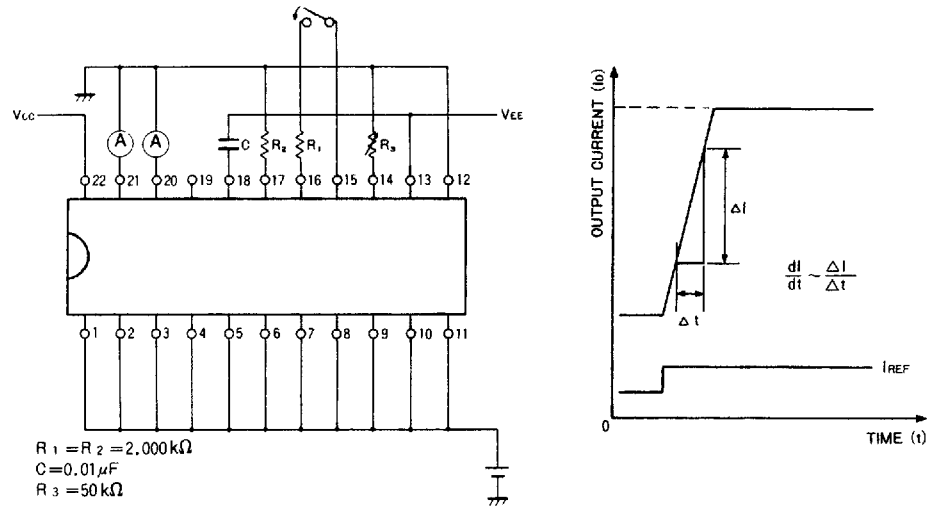


Figure 6 Input HIGH and LOW and input current I_{IN} test circuit

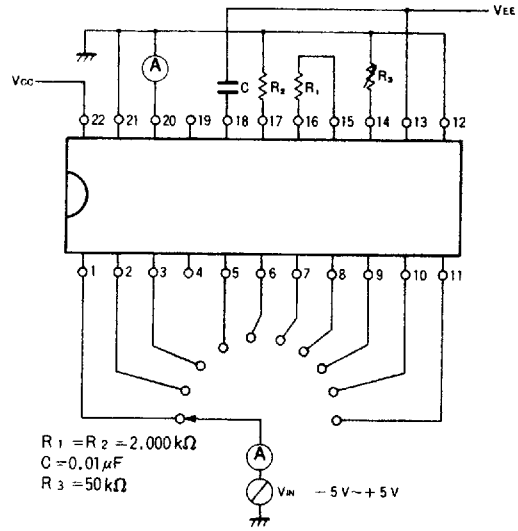


Figure 7 Circuit current I_{CC} and I_{EE} test circuit

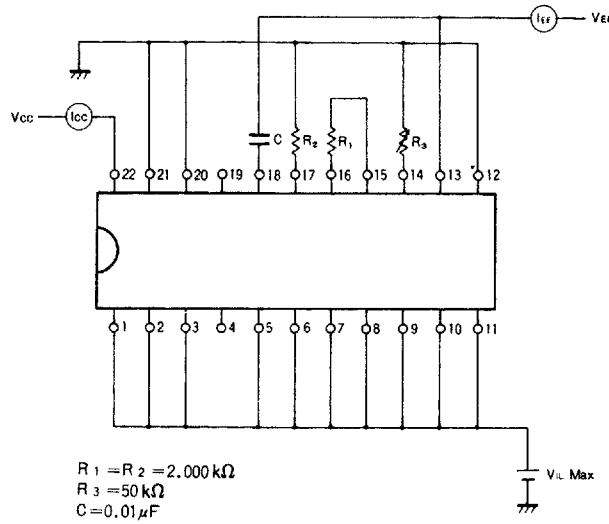
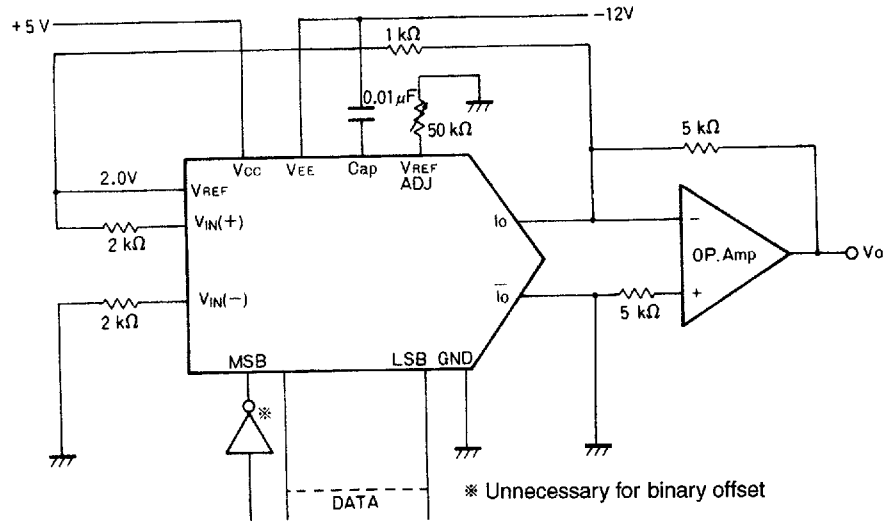


Figure 8 Application example



Electrical characteristic curves

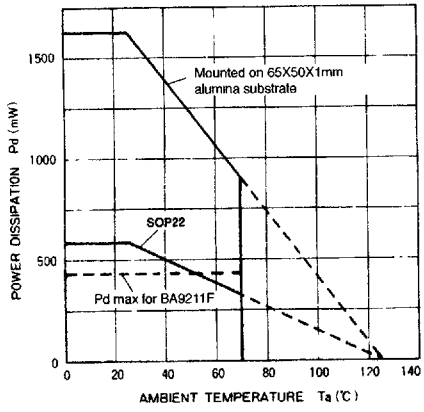


Figure 9

The maximum power consumption (P_{dMax}) of the BA9211F is about 400 mW. In the usable temperature range (0 ~ 70°C), make sure to mount the IC on a board with a good heat dissipation factor.