M5282FP

ELECTRONIC VOLUME CONTROL WITH MICROPHONE AMPLIFIER

DESCRIPTION

The M5282FP is an optimum IC for fade-in/fade-out control of video camera's input voice signals. The IC containes a linear-control VCA and low-noise OP amp.
Its applications cover general audio equipment and electronic musical instruments, such as voice volume controls in video cameras and 8mm cameras.

FEATURES

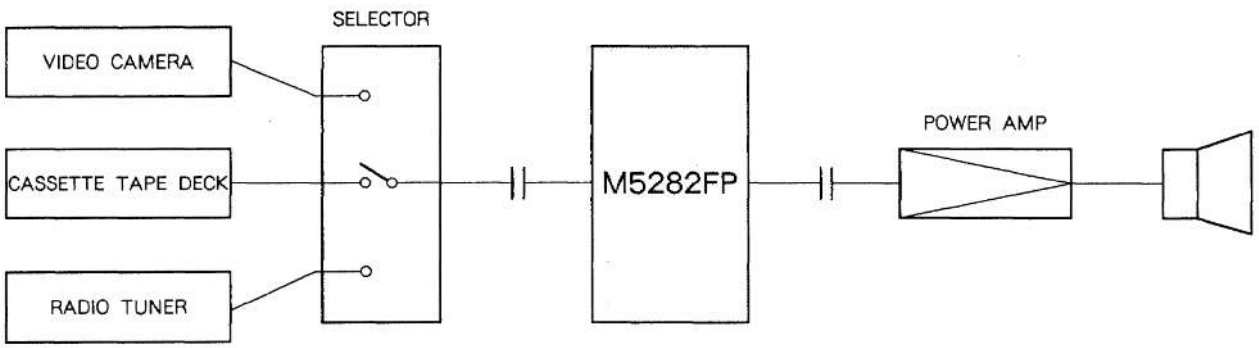
- Efficient VCA and OP amp are provided independently
- Voltage input/output type VCA
- Voltage gain can be set externally (OP amp section)
- Large ATT range ..... 0dB ~ – 82dB
- Built-in Vcc/2 bias terminal
- Can operate with low voltage (Vcc = 4.8V)

Outline 10P2-C
1.27mm pitch 300mil SOP
(5.3mm × 6.13mm × 1.75mm)

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ..... Vcc = 4.6 ~ 15V

SYSTEM CONFIGURATION



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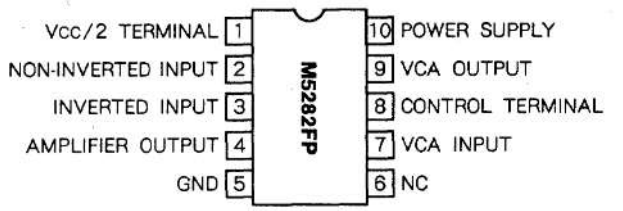
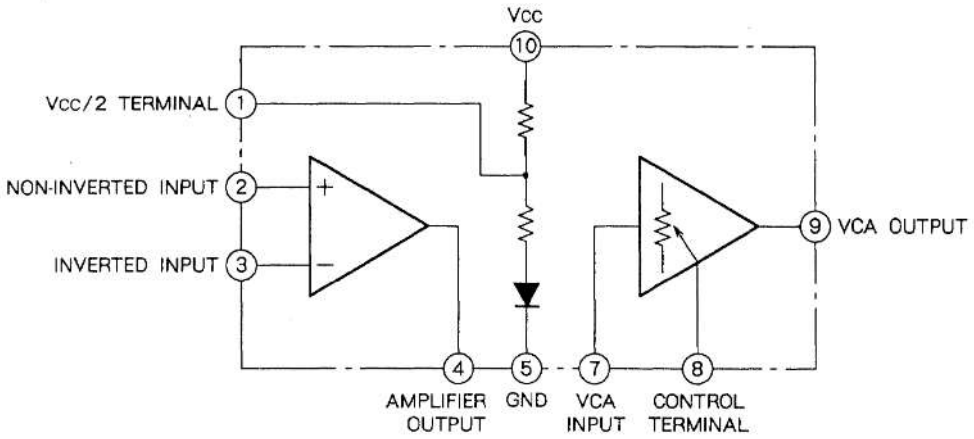
PIN CONFIGURATION



Outline 10P2-C

NC : NO CONNECTION

IC INTERNAL BLOCK DIAGRAM



MITSUBISHI ELECTRIC

PIN DESCRIPTION

Pin No.	Name	Symbol	Function
①	Vcc/2	Vcc/2 (COM)	Vcc/2 is obtained in the IC using divided voltage and is output to terminal ①. This can be used for the mid-point potential setup in the mike amplifier.
②	Mike amplifier non-inverted input	Amp + IN	This is the non-inverted input terminal of the mike amplifier. The mike amplifier's mid-point potenial is determined by connecting this terminal to terminal ① (Vcc/2 terminal) via a resistor (about 47kΩ). If you use this IC as a non-inverted amplifier, enter signals into this terminal. About 120nA (typ.) will be output from the IC as the input bias current.
③	Mike amplifier inverted input	Amp − IN	This is the output terminal of the mike amplifier. The feedback is applied from output terminal ④ of the mike amplifier to this terminal. The gain will be determined by the constant between this terminal and the output. About 120nA (typ.) will be output from the IC as the input bias current.
④	Mike amplifier output	Amp OUT	This is the output terminal of the mike amplifier. Input signals (having been set externally and arbitrary) whose gain has been doubled are output to this terminal.
⑤	Connected	GND	This is the GND terminal with the lowest IC. When you use this terminal, connect it to the ground.
⑥	Not connected	NC	This terminal is left open.
⑦	VCA input	VCA IN	VCA input terminal. If signals are input to this terminal from the mike amplifier's output, use a coupling capacitor (DC cutting capacitor).
⑧	Control	Vc	VCA control terminal. VCA output can be changed by applying DC voltage to this terminal. About 400nA of bias current is required for this terminal.
⑨	VCA output	VCA OUT	VCA output terminal
⑩	Power supply	Vcc	Power supply terminal at the HIGH side.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	15	V
P_d	Power dissipation	440	mW
K_θ	Thermal derating ($T_a \geqq 25℃$)	4.40	mW/℃
T_{opr}	Operating temperature	− 20 ~ + 75	℃
T_{stg}	Storage temperature	− 40 ~ + 125	℃

ELECTRICAL CHARACTERISTICS

ELECTRIC VOLUME (VCA) CHARACTERISTICS (Vcc = 4.8V, Ta = 25℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
ATT	Attenuation error	V_C = 4.8V, V_I = − 10dBm, f = 1kHz	− 2.0	− 0.3	+ 2.0	dB
ATT_M	Maximum attenuation	V_C = 0V, V_I = − 10dBm, f = 1kHz	− 77	− 82	−	dB
V_{IM}	Maximum input voltage	f = 1kHz, THD = 0.2%, V_C = 4.8V	0.6	0.7	−	Vrms
THD	Total harmonic distortion	f = 1kHz, V_O = 0.5Vrms, V_C = 4.8V	−	0.06	0.2	%
V_{NO}	Output noise voltage	Rg = 0, V_C = 4.8V	−	19	50	μ Vrms

MIKE AMPLIFIER CHARACTERISTICS (Vcc = 4.8V, Vc = 4.8V, Ta = 25℃, 40dB Amp., unless otherwise noted)

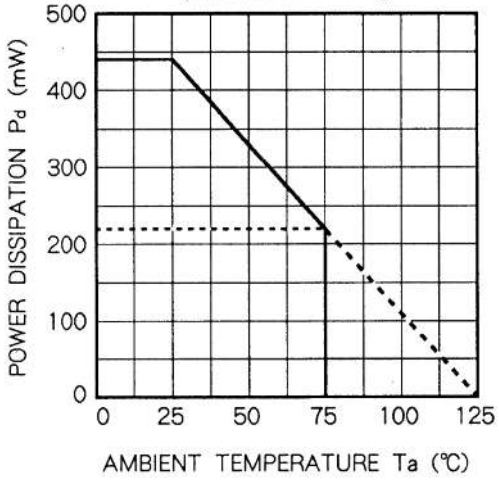
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{OM}	Maximum output voltage	THD = 0.2%	0.6	0.7	−	Vrms
THD	Total harmonic distortion	V_O = 0.5Vrms, f = 1kHz	−	0.01	0.2	%
V_{IN}	Input referred noise voltage	Rg = 1kΩ	−	0.5	1.0	μ Vrms

TOTAL (VCA+MIKE AMP.) CHARACTERISTICS (V_{CC} = 4.8V, Ta = 25℃, unless noted)

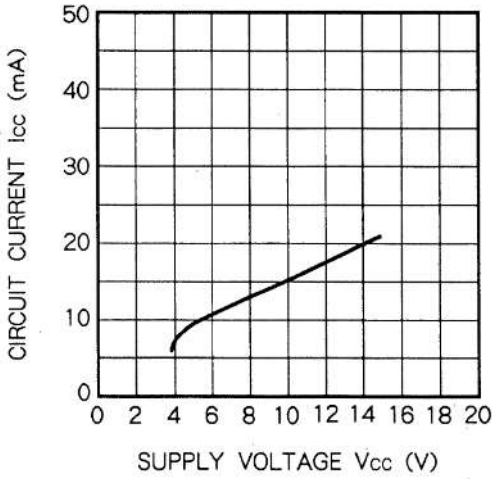
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{IN} = 0	–	8.7	13.0	mA
V_{OM}	Maximum output voltage	f = 1kHz, THD = 0.2%	0.6	0.7	–	Vrms
THD	Total harmonic distortion	f = 1kHz, V_O = 0.5Vrms	–	0.06	0.2	%
V_{NO}	Output noise voltage	R_g = 1k Ω	–	60	120	μ Vrms
S/N	Signal to noise voltage (1)	R_g = 1k Ω, V_i = 3.5mVrms	69	75	–	dB
S/N	Signal to noise voltage (2)	R_g = 1k Ω, V_i = 0.3mVrms	48	54	–	dB

TYPICAL CHARACTERISTICS

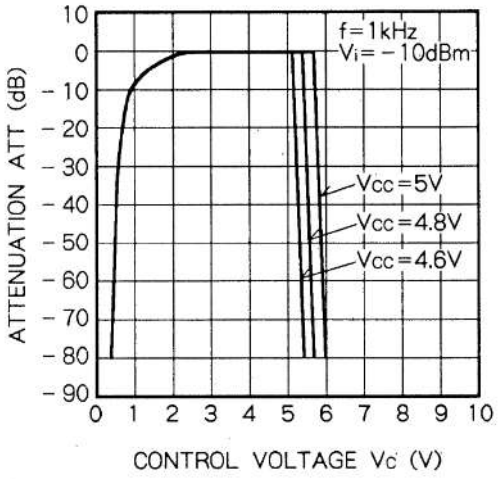
THERMAL DERATING (MAXIMUM RATING)



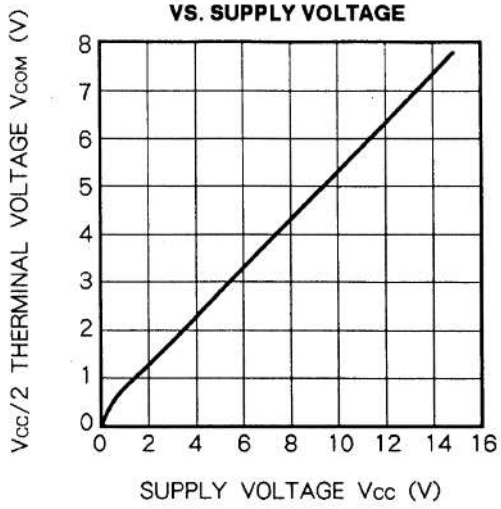
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



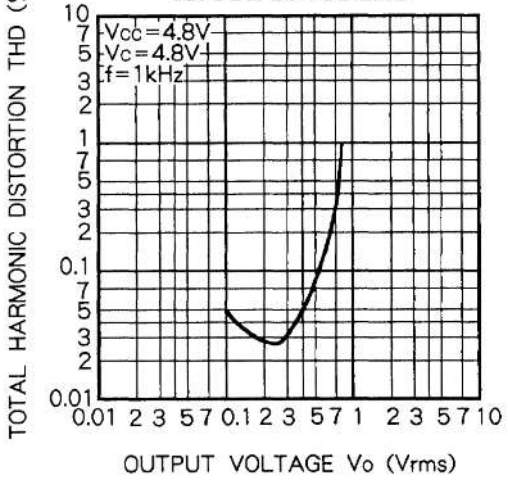
ATTENUATION VS. CONTROL VOLTAGE



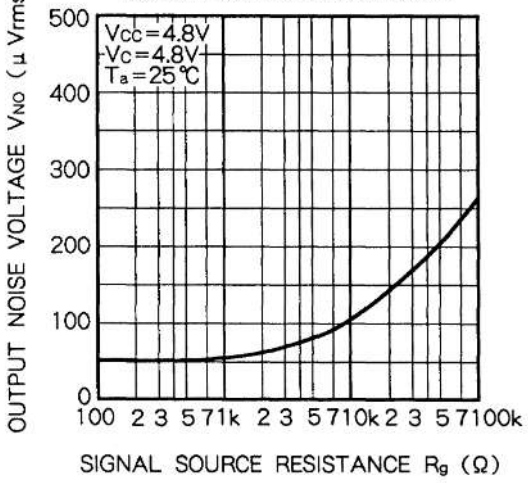
Vcc/2 THERMINAL VOLTAGE VS. SUPPLY VOLTAGE



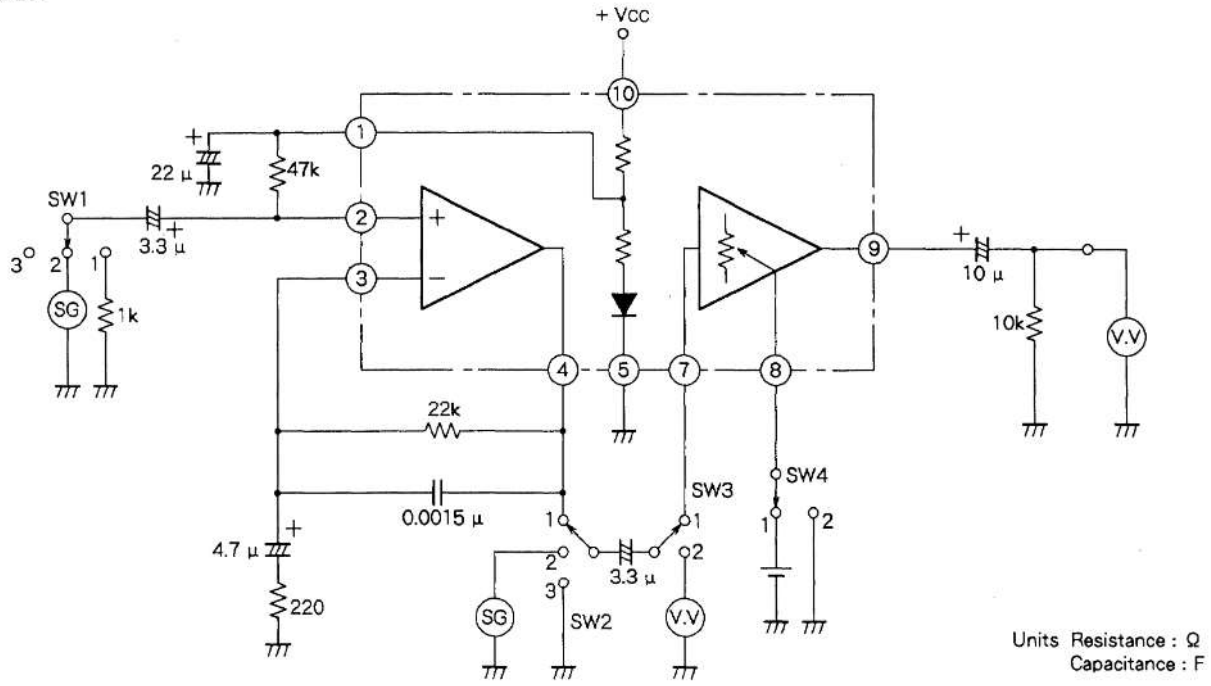
TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE



OUTPUT NOISE VOLTAGE VS. SIGNAL SOURCE RESISTANCE



TEST CIRCUIT



Units Resistance : Ω
Capacitance : F

Switch matrix electronic volume (VCA) chracteristics

	SW1	SW2	SW3	SW4
ATT	1	2	1	1
ATT_M	1	2	1	2
V_{OM}	1	2	1	1
THD	1	2	1	1
V_{NO}	1	3	1	1

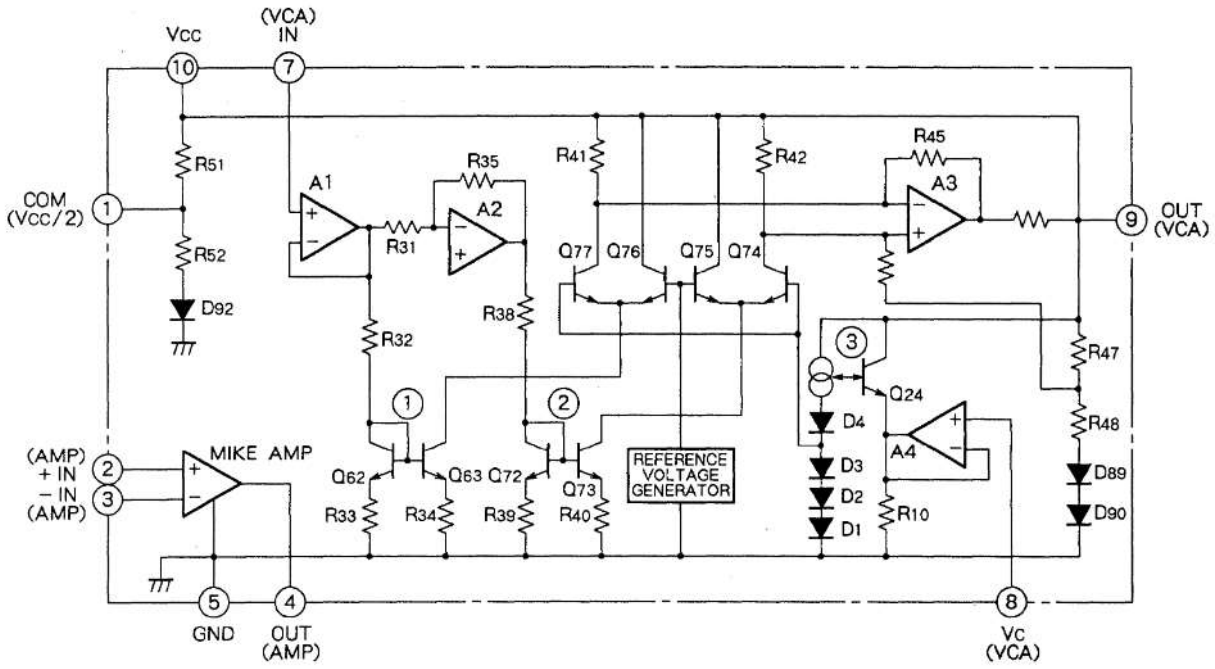
Mike amplifier chracteristics

	SW1	SW2	SW3	SW4
V_{OM}	2	1	2	1
THD	2	1	2	1
V_{NO}	1	1	2	1

TOTAL (VCA+Mike Amp.) Chracteristics

	SW1	SW2	SW3	SW4
I_{CC}	3	1	1	1
V_{OM}	2	1	1	1
THD	2	1	1	1
V_{NO}	1	1	1	1

DESCRIPTION OF OPERATIONS (BLOCK DIAGRAM)



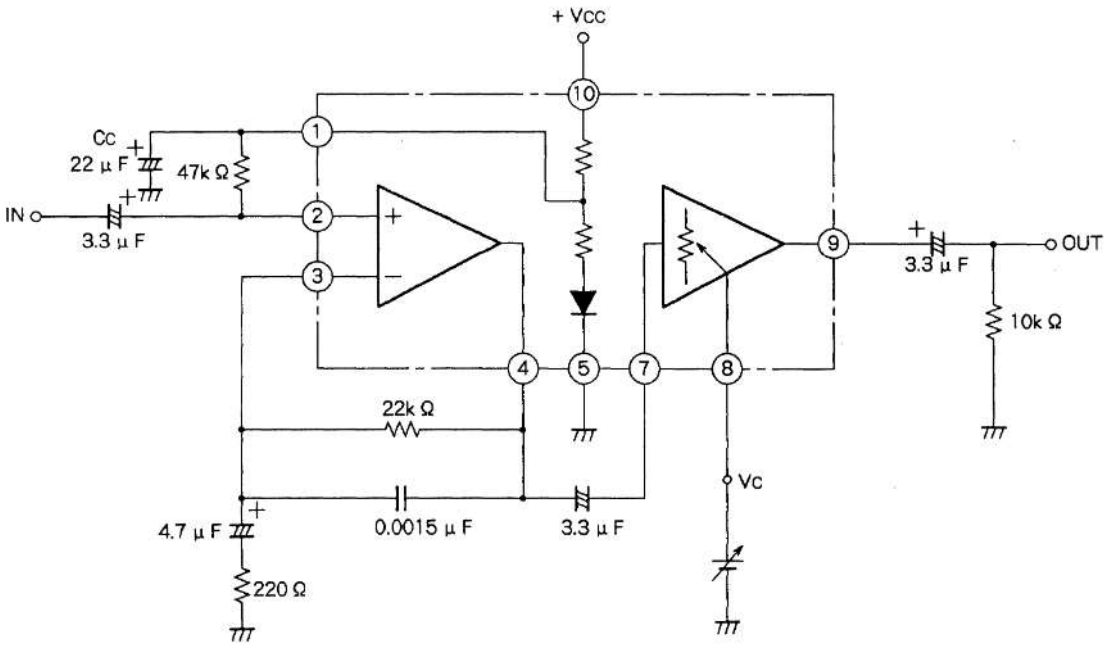
This section shows the basic block diagram of the M5282FP and descrides its operations.

Input signals from the VCA (terminal ⑦) flow via the buffer amplifier A_1 and are converted to in-phase current signals by R_{32}. Also, the input voltage which has been inverted by the input amplifier A_2 is converted into current signals by R_{36}. These signals are sent to the differential circuits (consisting of Q_{74} to Q_{77}) by current mirrors ① and ②.

Collectors of Q_{74} and Q_{77} in the differential circuit are connected to the next differential amplifier's + and − inputs, respectively. The potential of Q_{74} collector is determined by the current sent from current mirrors of Q_{72} and Q_{73} and resistor R_{42}. The potential of Q_{77} collector becomes the same due to the differential amplifier A_3 and the same current flows into R_{41} and R_{42}. Current signals sent to differential circuits Q_{77} and Q_{76} are antiphase, resulting in the difference between the current of R_{41} and that of collector Q_{77}. This will be voltage converted by the differential amplifier A_3 to be output.

The DC potential of the Vc terminal is given to R_{10} by the buffer amplifier A_4, converted into the current, and sent to D_1 to D_3 by the current mirror ③. The $VF = kT/q \cdot \ln IF/IS$) for this current is generated and given to the base of Q_{74} and Q_{77}. By changing the balance of differential circuits Q_{74}, Q_{75}, Q_{76} and Q_{77}, the attenuation chracteristics can be obtained because the gm changes.

APPLICATION EXAMPLE



NOTE ON USAGE

1. 0dB and one time of amplification are obtained while internal differential circuits are gathered to the Q_{77} and Q_{74} side (see the OPERATING DESCRIPTION BLOCK DIAGRAM) on the VCA section (control voltage is about 3V, see the ATTENUATION VS. CONTROL VOLTAGE graph).
2. Signal phase input to VCA IN is output to VCA OUT.
3. Although the control voltage can be given in the range of 0 to Vcc, the voltage needed for the attenuation change is from 0.5V to 3V (see the ATTENUATION VS. CONTROL VOLTAGE). Therefore, it is recommended that the IC be used within the range of 0V to 5V.
4. About 400nA (typ) of bias current is needed for the control terminal.
5. The Vcc/2 terminal level-shifts the VF of the diode to cancel out the unbalance the left voltages of the up- and down-side mike amplifiers.
6. To decrease the impedance of the COM terminal (Vcc/2 terminal), connect the capacitor Cc between the COM AND GND terminals.