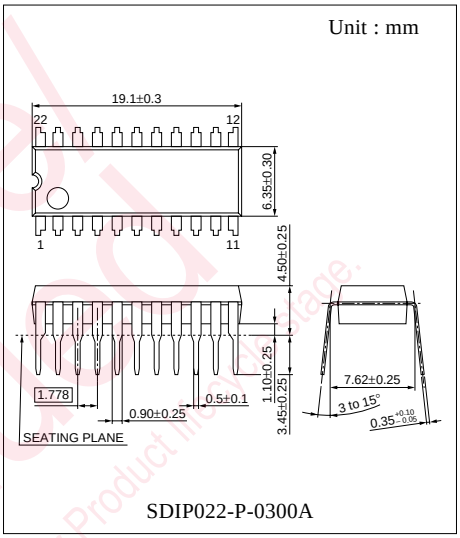
AN7328K

Pre-settable Equalizer IC for Radio-Cassette

■ Overview

The AN7328K is an IC designed for radio cassette equalizers with five preset modes making it possible to select one of the five frequency response characteristics. By using this IC as the prestage circuit of an output amplifier, audio output with optimum tone characteristics according to rock, pop, flat, jazz, or classical music is obtainaed.



SDIP022-P-0300A

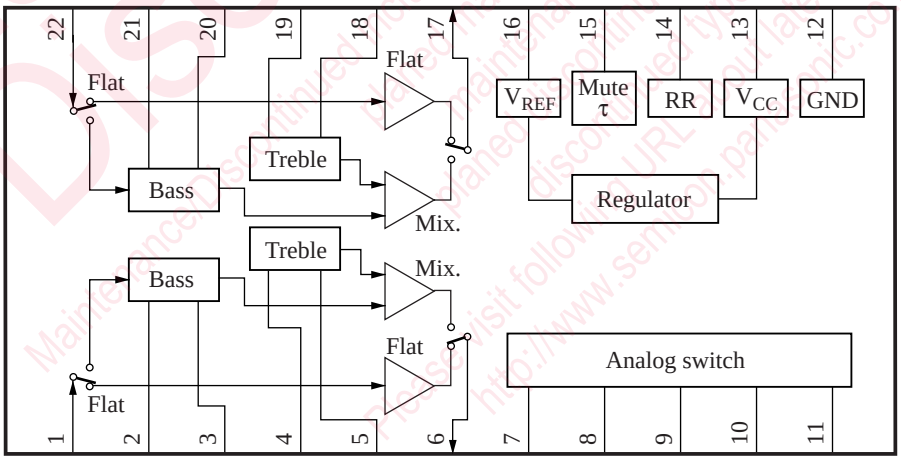
■ Features

- Equalizer characteristics with peaking audio frequencies of 100 Hz and 7 kHz are available in five different modes
- The rock mode is automatically selected as a default setting
- Microcomputer control possible
- Low operating voltage (Supply voltage : 3.6 V min.)

■ Applications

- Stereo radio cassette recorder with built-in CD player
- Portable stereo set

■ Block Diagram



■ Pin Descriptions

Pin No.	Description	Pin No.	Description
1	R-ch. input	12	GND
2	R-ch. negative feedback 1	13	V_{CC}
3	R-ch. bass	14	Ripple rejection
4	R-ch. treble	15	Mute τ
5	R-ch. negative feedback 2	16	Reference voltage
6	R-ch. output	17	L-ch. output
7	Classic	18	L-ch. negative feedback 2
8	Rock	19	L-ch. treble
9	Jazz	20	L-ch. bass
10	Pops	21	L-ch. negative feedback 1
11	Flat	22	L-ch. input

■ Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{CC}	14	V
Supply current	I_{CC}	50	mA
Power dissipation	P_D	700	mW
Operating ambient temperature *	T_{opr}	–25 to +75	°C
Storage temperature *	T_{stg}	–55 to +150	°C

Note) * : Except these items, all other measurements are taken at T_a = 25 °C.

■ Recommended Operating Range

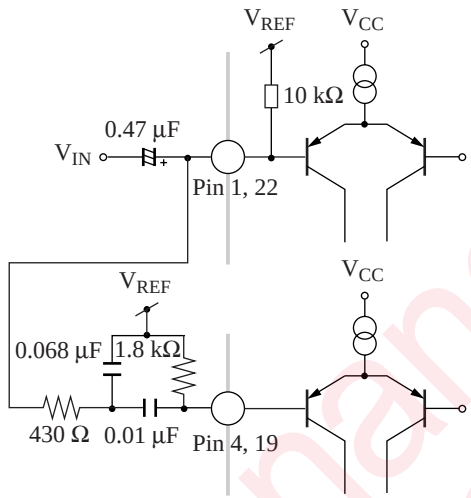
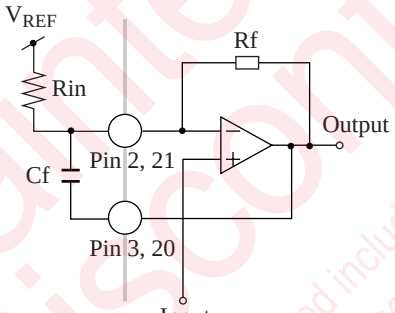
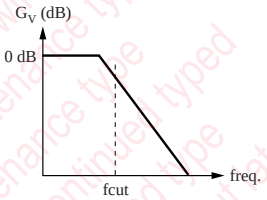
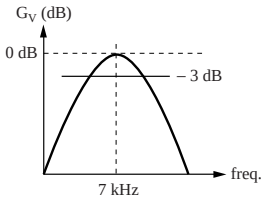
Parameter	Symbol	Range	Unit
Supply voltage	V_{CC}	3.6 to 12	V

■ Electrical Characteristics at V_{CC} = 6 V, freq. = 1 kHz, T_a = 25 °C,Flat mode,unless otherwise specified

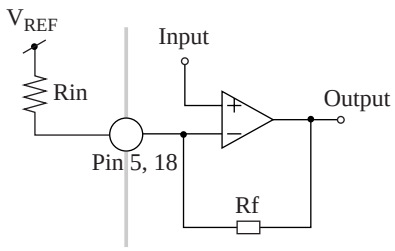
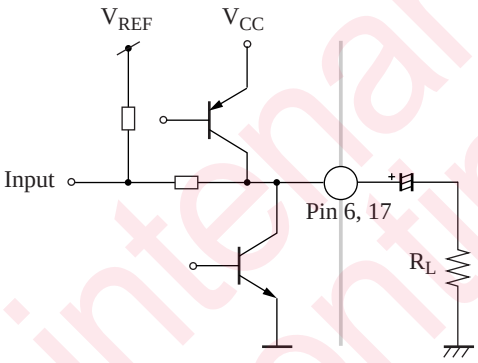
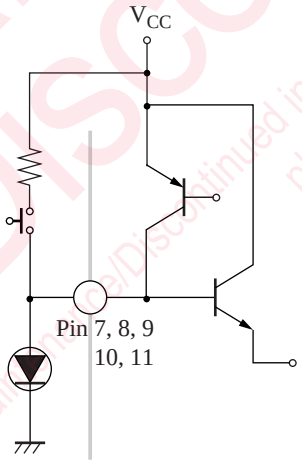
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Quiescent current	I_{CQ1}	No input	10.5	15.0	19.5	mA
Channel balance	CB	V_{INL} = 0.1 V, V_{INR} = 0.1 V	–1	0	1	dB
Reference voltage	V_{REF}	No input	2.4	3.4	4.3	V
Ripple rejection	RR	V_R = 0.1 V, f_R = 100 Hz	35	40	—	dB
Channel separation	CS	V_{IN} = 0.1 V, Measure V_{OUT}	35	40	—	dB
Output noise *	V_{NO}	V_{IN} = 0 V, R_G = 2.2 kΩ	—	10	20	μV
THD (1 kHz) *	THD1	V_{IN} = 0.1 V	—	0.1	0.3	%
Gain (100 Hz)	G_{V1}	V_{IN} = 0.1 V	–2.0	– 0.5	2.0	dB
Gain (7 kHz)	G_{V2}	V_{IN} = 0.1 V	–2.0	0.5	2.0	dB
Maximum output voltage	V_{OM}	THD = 1 %,R_L = 10 kΩ	0.6	1.0	1.4	V_{rms}
Channel (Classic)						
Quiescent current	I_{CQ2}	No input	11.5	16.0	20.5	mA
Gain (100 Hz)	G_{V3}	V_{IN} = 0.1 V	2	4	6	dB
Gain (7 kHz)	G_{V4}	V_{IN} = 0.1 V	2	4	6	dB
Channel (Rock)						
Quiescent current	I_{CQ3}	No input	10.5	14.5	19.0	mA
Gain (100 Hz)	G_{V5}	V_{IN} = 0.1 V	6	8	10	dB
Gain (7 kHz)	G_{V6}	V_{IN} = 0.1 V	6	8	10	dB
Channel (Jazz)						
Quiescent current	I_{CQ4}	No input	10.5	14.5	19.0	mA
Gain (100 Hz)	G_{V7}	V_{IN} = 0.1 V	6	8	10	dB
Gain (7 kHz)	G_{V8}	V_{IN} = 0.1 V	2	4	6	dB
Channel (Pops)						
Quiescent current	I_{CQ5}	No input	10.5	14.5	19.5	mA
Gain (100 Hz)	G_{V9}	V_{IN} = 0.1 V	2	4	6	dB
Gain (7 kHz)	G_{V10}	V_{IN} = 0.1 V	6	8	10	dB
Channel (Classic)						
THD (1 kHz) *	THD2	V_{IN} = 0.1 V	—	0.25	0.3	%
Channel (Rock)						
THD (1 kHz) *	THD3	V_{IN} = 0.1 V	—	0.25	0.3	%
Channel (Jazz)						
THD (1 kHz) *	THD4	V_{IN} = 0.1 V	—	0.25	0.3	%
Channel (Pops)						
THD (1 kHz) *	THD5	V_{IN} = 0.1 V	—	0.25	0.3	%

Note) * : DIN audio filter used

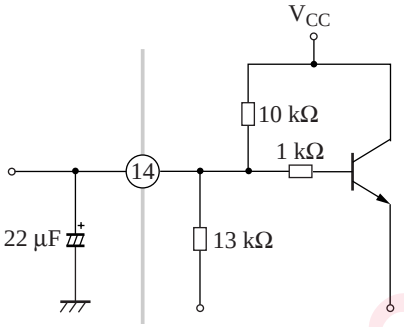
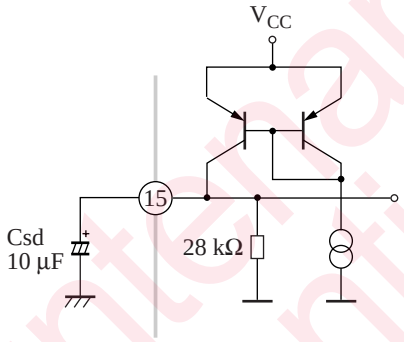
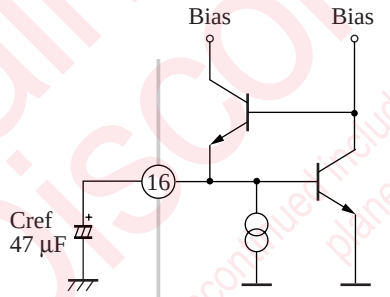
■ Terminal Equivalent Circuits

Pin No.	Equivalent Circuit	Description	DC Bias (V)
1		Bass input for R-ch. : These are the inputs to the IC. These inputs can be from PRE or VOL block,through a 0.47 µF cap. I/P impedance ≈ 5.8 kΩ	3.40
2 3		Negative feedback pin & Pass filter pin : C_F and R_{IN} form a low pass filter and its cutoff frequency can be changed by varying C_F.  G_V can be changed by varying R_{IN} externally.	3.40
4	Refer to Pin1	Treble input for R-ch. : The output signal of previous stage will go through a filtering network before input to this pin. Impedance ≈ decided by the filter network. NB : Peak frequency can be changed by varying capacitor value. 	3.40

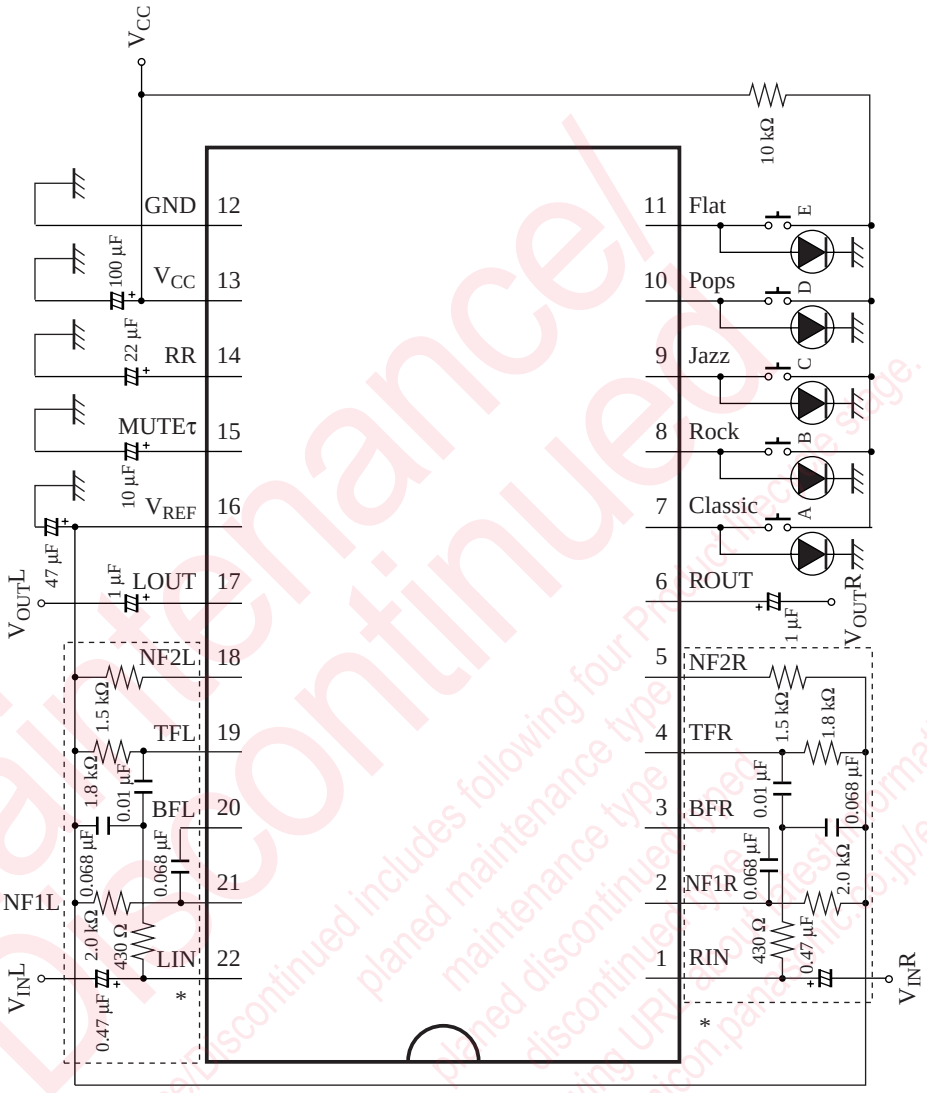
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent Circuit	Description	DC Bias (V)
5		Nagative feedback pin for Treble : G_V can be changed by varying R_{IN} externally.	3.40
6		Output pin for R-ch. : Pushpull output pin for connecting to the next stage through a coupling capacitor. $Z_{OUT} \approx 75\ \Omega$	3.40
7 8 9 10 11		Analog Switch : Switch pin for Rock,Pops,Jazz,Classic & Flat,with initial mode set at Rock mode. The current source circuit provides the ability to drive the LED indicators. The average current is about 2 mA. If the LED indicators need more than 2 mA, additional transistor is needed. Please refer to the application notes. Selected mode has a bias of 2.45 V & other pins have bias of 0 V.	2.45 or 0
12	—	GND	0.00
13	—	V_{CC}	6.00

■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent Circuit	Description	DC Bias (V)
14		Ripple Rejection : To connect with a capacitor to minimize ripple generated from V_{CC} source.	5.00
15		Mute τ : To connect with a capacitor to mute pop noise. The time constant of the mute pulse may be changed by varying C_{SD}.	1.60
16		Reference Voltage : Provide fixed DC bias, which is slightly above 1/2 V_{CC} to allow for bigger dynamic range.	3.40
17	Refer to Pin6	Output pin for L-ch. : Refer to Pin6	3.40
18	Refer to Pin5	Nagative feedback pin for Treble : Refer to Pin5	3.40
19	Refer to Pin4	Treble input for L-ch. : Refer to Pin4	3.40
20	Refer to Pin2	Negative feedback pin & Pass filter pin : Refer to Pin2	3.40
21	Refer to Pin2	Negative feedback pin & Pass filter pin : Refer to Pin2	3.40
22	Refer to Pin1	Bass input for L-ch. : Refer to Pin1	3.40

■ Application Circuit Example



Note) * : For more information regarding frequency response characteristics and LED indicator interfacing, please refer to application notes.

■ Application Note

- Preset graphic equaliser

This IC provides 5 preset modes by means of 5 push button switches, with built-in LED indicator.

The boosting frequencies are 100 Hz and 7 kHz.

A) Rock

By pressing this switch, both 100 Hz and 7 kHz signal are boosted by 8 dB.

This is the initial preset mode, i.e. when V_{CC} is turn ON, this mode will be ON automatically.

B) Pops

This preset mode will boost 100 Hz signal by 4 dB and 7 kHz signal by 8 dB.

C) Flat

There is a built-in buffer for this mode to pass the signal directly to output without processing.

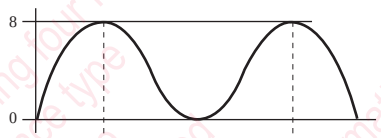
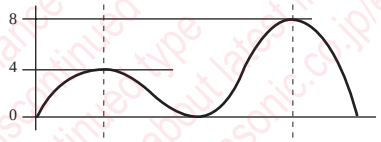
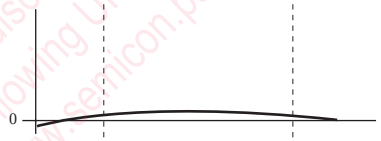
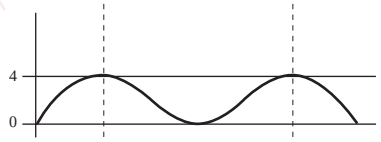
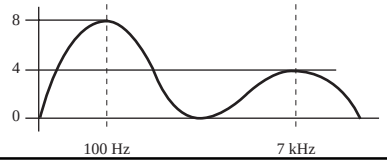
D) Classic

This mode will boost both 100 Hz and 7 kHz signal by 4 dB.

E) Jazz

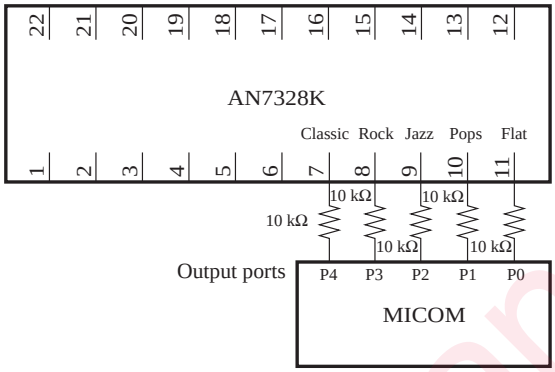
This preset mode will boost 100 Hz signal by 8 dB and 7 kHz signal by 4 dB.

- Frequency response curve

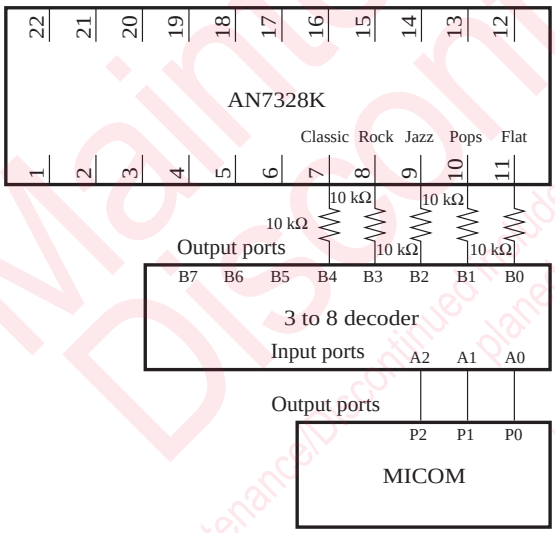
	100 Hz	7 kHz	Response curve
Rock	+ 8 dB	+ 8 dB	
Pops	+ 4 dB	+ 8 dB	
Flat	—	—	
Classic	+ 4 dB	+ 4 dB	
Jazz	+ 8 dB	+ 4 dB	

■ Application Note (continued)

• Interfacing with microcomputer



MICOM O/P					Selected
P4	P3	P2	P1	P0	mode
L	L	L	L	H	Flat
L	L	L	H	L	Pops
L	L	H	L	L	Jazz
L	H	L	L	L	Rock
H	L	L	L	L	Classic



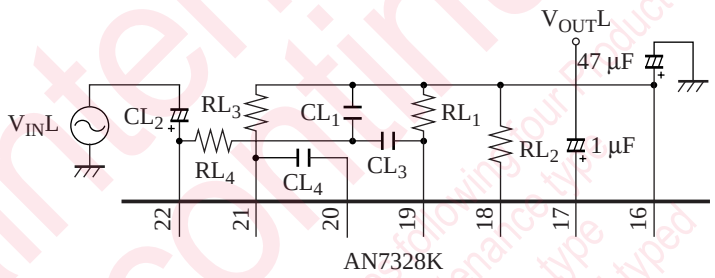
MICOM O/P			Decoder O/P					Selected
P2	P1	P0	B4	B3	B2	B1	B0	mode
L	L	L	L	L	L	L	H	Flat
L	L	H	L	L	L	H	L	Pops
L	H	L	L	L	H	L	L	Jazz
L	H	H	L	H	L	L	L	Rock
H	L	L	H	L	L	L	L	Classic

■ Application Note (continued)

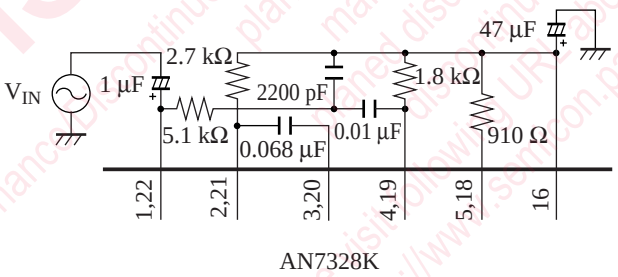
1. This IC has two peak frequencies (100 Hz & 7 kHz) which can be adjusted by varying external component value. Below is a table of gain,frequency shift vs external component value.

	Peak freq. (100 Hz)		Peak freq. (7 kHz)		Low freq. gain		High freq. gain	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
RL_1	—	—	↓	↑	—	—	↑	↓
RL_2	—	—	—	—	—	—	↓	↑
RL_3	—	—	—	—	↓	↑	—	—
RL_4	—	—	↓	↑	—	—	↓	↑
CL_1	—	—	↓	↑	—	—	↓	↑
CL_2	—	—	—	—	↑	↓	—	—
CL_3	—	—	↓	↑	—	—	↑	↓
CL_4	↓	↑	—	—	—	—	—	—

↑ Increase component value and ↓ Decrease component value

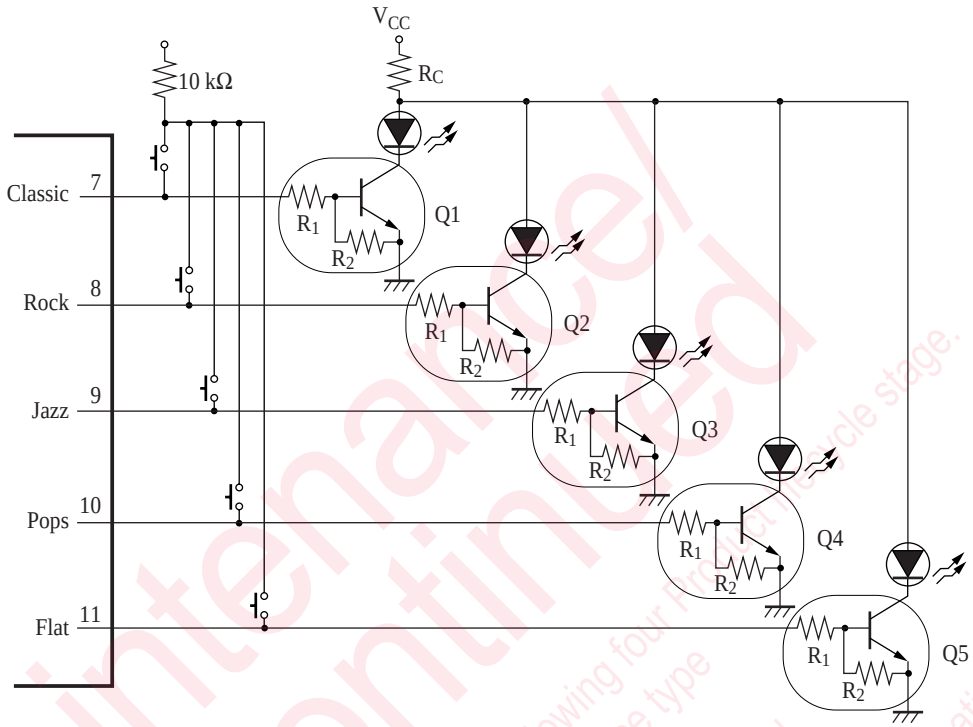


2. If the previous stage has high output impedance (Z_{OUT}), this may cause the output drop at high frequency. In this situation, the following circuit is recommended to improve the high frequency performance.



■ Application Note (continued)

Interfacing with LED indicators whose the current exceed 2 mA.



Transistor	Built-in resistor	Electrical characteristics
Q2 (Rock)	R_1 = 10 kΩ R_2 = 10 kΩ	IC = 100 mA h_{FE} = 35 (min.) to 100 (max.)
Q1 (Classic) Q3 (Jazz) Q4 (Pops) Q5 (Flat)	R_1 = 4.7 kΩ R_2 = 10 kΩ	IC = 100 mA h_{FE} = 35 (min.) to 100 (max.)

e.g. R_C = 390 Ω

Pin voltage to turn on LED is ≈ 2.5 V.

V_{LED} = 2.68 V, LED current ≈ 13 mA

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(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.