Dual Supply Grand Earthing System Audio Signal Mute IC

FEATURES

- Wide Voltage Range (±2.5 to ±5.5 V)
- High Volume Attenuation (typ. -89dB)
- Very Low Signal Distortion (typ. 0.0025%)
- High Maximum Input Voltage (max. 5.2 V_{P-P})
- Very Low Standby Current (typ. 0.6 mA)
- Minimal External Component Circuitry

APPLICATIONS

- Audio Systems
- Television
- VTR
- MD
- CD

DESCRIPTION

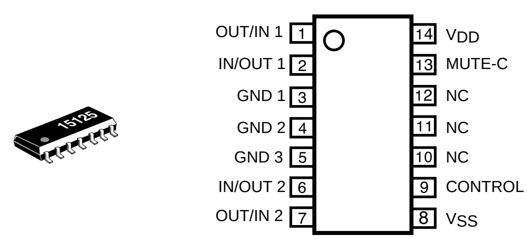
The TK15125M is a dual power supply Mute IC of the Grand Earthing System that was developed as a low frequency signal attenuator for audio products.

The mute function includes two channels which operate simultaneously by one control key.

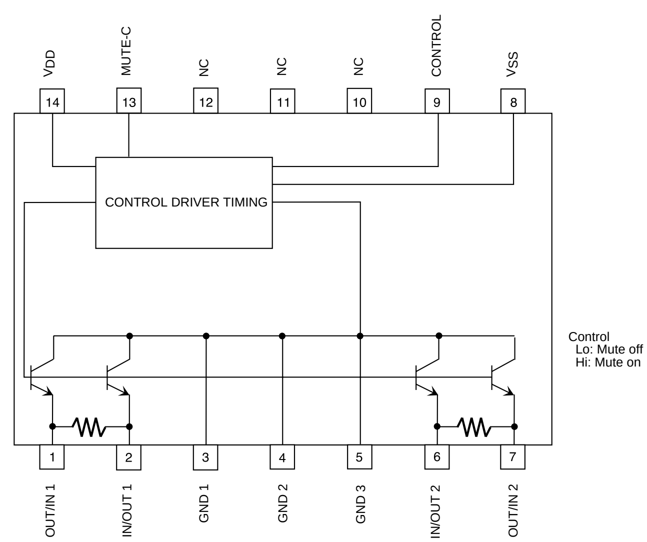
The optional time for the Attack/Release action can be set up by an external timing control capacitor.

The TK15125M is available in a SOP-14 Surface Mount Package.

TK15125



BLOCK DIAGRAM



ORDERING INFORMATION

TK15125M □□

Tape/Reel Code

TAPE/REEL CODE
TL: Tape Left

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... ±6 V
Power Dissipation (Note 3) .... 350 mW
Input Frequency ....100 kHz
Storage Temperature Range .... -55 to +150 °C
Operating Temperature Range ....-20 to +60 °C
Signal Input Voltage .... V_{SS} to V_{DD}

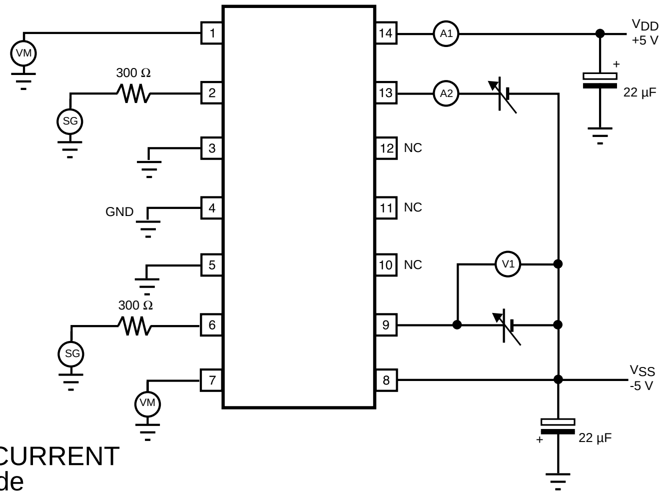
TK15121M ELECTRICAL CHARACTERISTICS

Test conditions: V_{CC} = ±5 V, T_A = 25 °C, f = 1 kHz, V_{SIN} = 5 V_{P-P} unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
V_{DD}	Operating Voltage		2.5	5.0	5.5	V
V_{SS}			-2.5	-5.0	-5.5	V
$I_{DD (OFF)}$	Operating Current, Mute Off			0.6	0.9	mA
$I_{DD (ON)}$	Operating Current, Mute On			12.0	17.0	mA
ATT	Attenuation	R_{IN} = 300 Ω (Note 1)	-85	-89		dB
CI_{ON}	Mute On Charge Current		8.0	12.0	18.0	µA
CI_{OFF}	Mute Off Discharge Current	(Note 2)	1.8	3.0	5.0	µA
SWV_{OFF}	Mute Control SW, Mute Off Voltage		V_{SS}		V_{SS} + 0.4	V
SWV_{ON}	Mute Control SW, Mute On Voltage		V_{SS} + 2.4		V_{DD}	V
SWI_{ON}	Mute Control SW, Mute On Current			16	25	µA
V_{OSAT}	Mute On Output DC Voltage			2.4	3.7	mV
THD 1	Mute Off Total Harmonic Distortion			0.0025	0.0070	%
THD 2		JIS-A Filter ON		0.0007	0.0030	%
GVA	Voltage Gain	dB = ~20 kHz	-0.5	0	+0.5	dB
$V_{IN (MAX)}$	Maximum Input Voltage	THD < 0.01%			5.2	V_{P-P}
MR	Inner Attenuation Resistance		168	240	312	Ω

Note 1: If an R_{IN} other than 300 Ω is used, the volume attenuation and attack/release times change.
Note 2: In the standard application a capacitor is connected between Pin 13 and V_{SS}. Attack is the term used to describe the action of changing the unit from 'mute off' to 'mute on'. Release is the term used to describe the action of changing the unit from 'mute on' to 'mute off'. The standard timing control capacitance is 0.047 µF.
Note 3: Power dissipation is 350 mW when mounted as recommended. Derate at 2.8 mW/°C for operation above 25°C.

TEST CIRCUIT AND TESTING METHODS



TESTING METHODS

1) POWER SUPPLY CURRENT
- 'MUTE OFF' Mode
  Measure current 'A1' while control, Pin 9, is 'Lo' (or open).
- 'MUTE ON' Mode
  Measure current 'A1' while control, Pin 9, is 'Hi'.

2) ATTENUATION VOLUME
- Attenuation is calculated by the following equation while control, Pin 9, is 'Hi':

$$ATT = 20Log\left(\frac{\text{Pin 1(Pin 7) output AC voltage}}{\text{Pin 2(Pin 6) input AC voltage}}\right)$$

3) CAPACITOR PIN CHARGING AND DISCHARGING CURRENT
- Charging Current
  Measure outflow current 'A2' while control, Pin 9, is 'Hi' and the voltage at Pin 13 is V_{SS} + 0.75 V.
- Discharging Current
  Measure inflow current 'A2' while control, Pin 9, is 'Lo (or open)' and the voltage at Pin 13 is V_{SS} + 0.75 V.

4) CONTROL SWITCH VOLTAGE
- 'MUTE OFF' Mode
  Gradually elevate Pin 9 voltage above V_{SS}. When the Attack action (Mute On) is implemented at Pin 1 (Pin 7), measure the voltage 'V1'.
- 'MUTE ON' Mode
  Gradually lower Pin 9 voltage below V_{DD}. When the Release action (Mute Off) is implemented at Pin 1 (Pin 7), measure the voltage 'V1'.

5) 'MUTE ON' OUTPUT DC VOLTAGE
- Measure output voltage at Pin 1 (Pin 7) while control, Pin 9, is 'Hi' and there is no input.

6) TOTAL HARMONIC DISTORTION
- Measure the distortion of the Pin 1 (Pin 7) output while control, Pin 9, is 'Lo' (or open).

7) SIGNAL VOLTAGE GAIN
- Signal gain is calculated by the following equation while control, Pin 9, is 'Lo' (or open).

$$GV = 20Log\left(\frac{\text{Pin 1(Pin 7) output AC voltage}}{\text{Pin 2(Pin 6) input AC voltage}}\right)$$

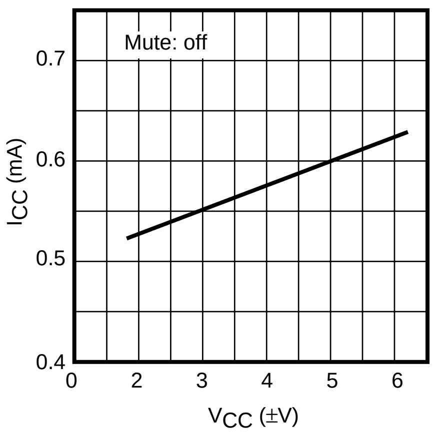
8) INNER ATTENUATION RESISTANCE
- Using a multimeter, measure the resistance between Pin 1 (Pin 7) and Pin 2 (Pin 6) while the power supply is off.

9) MAXIMUM INPUT SIGNAL VOLTAGE
- While control, Pin 9, is 'Lo' (or open), gradually elevate Pin 2 (Pin 6) voltage above 0 V_{P-P}. When the distortion becomes 0.01% at the output of Pin 1 (Pin 7), measure the AC voltage.

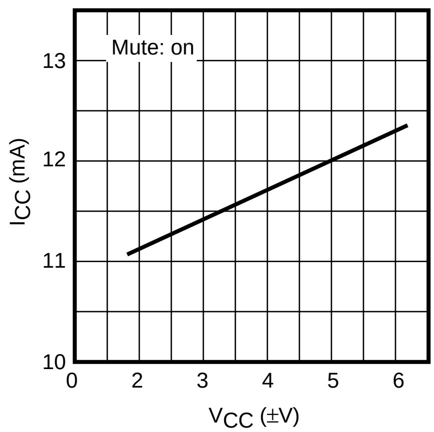
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25 °C, unless otherwise specified.

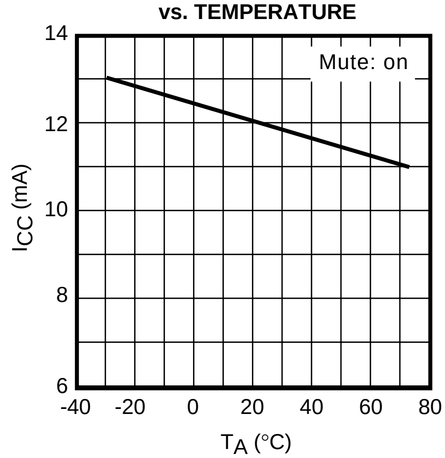
SUPPLY CURRENT vs. SUPPLY VOLTAGE



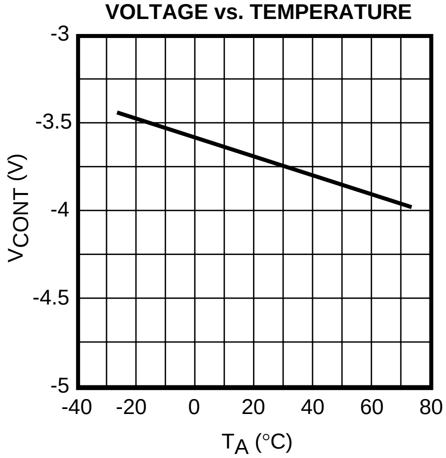
SUPPLY CURRENT vs. SUPPLY VOLTAGE



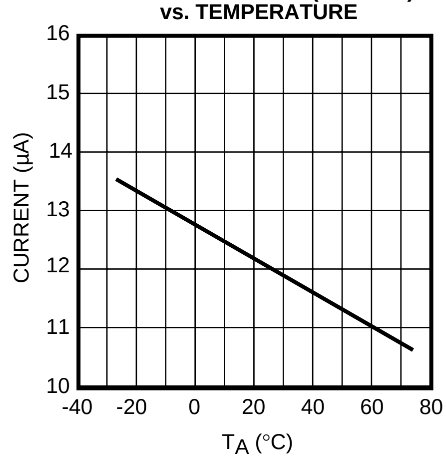
SUPPLY CURRENT vs. TEMPERATURE



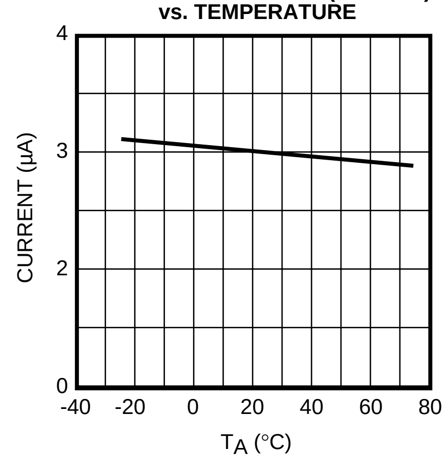
CONTROL THRESHOLD VOLTAGE vs. TEMPERATURE



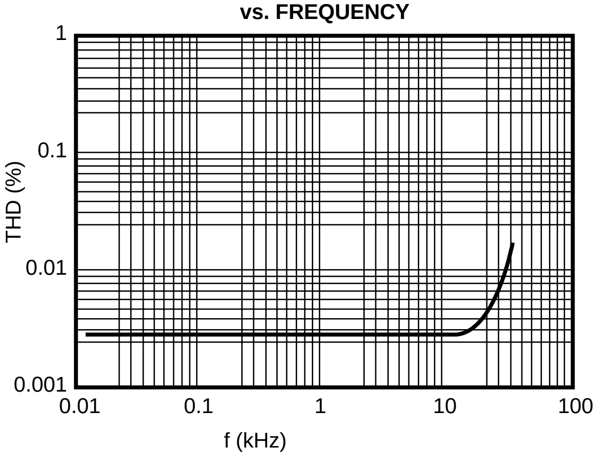
CHARGE CURRENT (Mute Pin) vs. TEMPERATURE



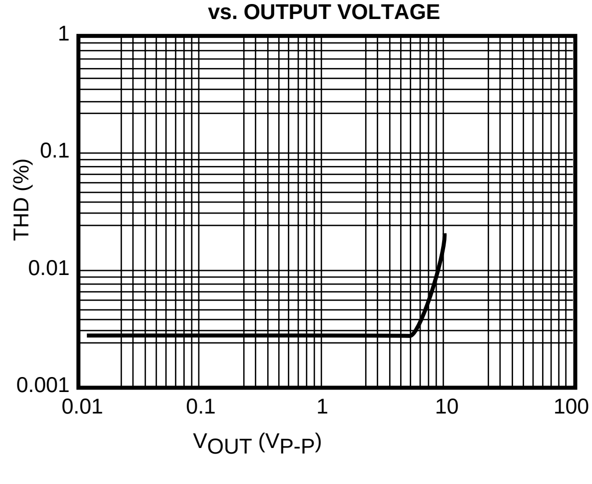
DISCHARGE CURRENT (Mute Pin) vs. TEMPERATURE



TOTAL HARMONIC DISTORTION vs. FREQUENCY

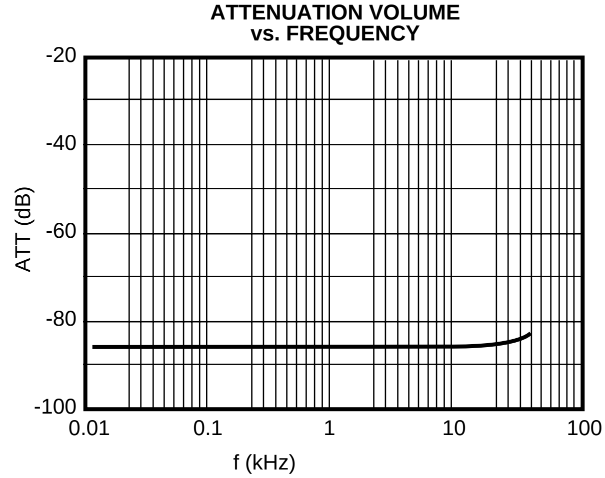


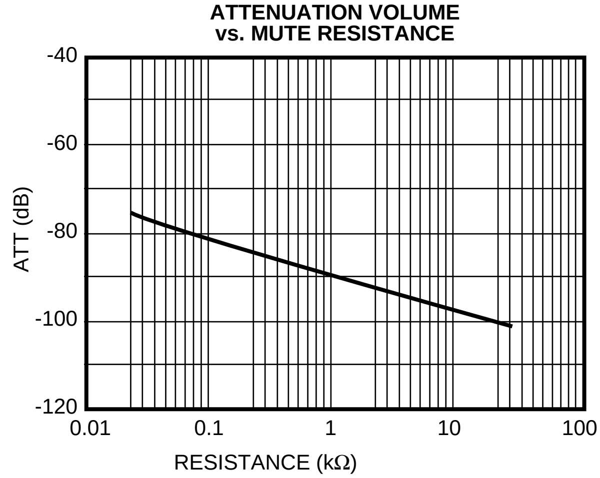
TOTAL HARMONIC DISTORTION vs. OUTPUT VOLTAGE

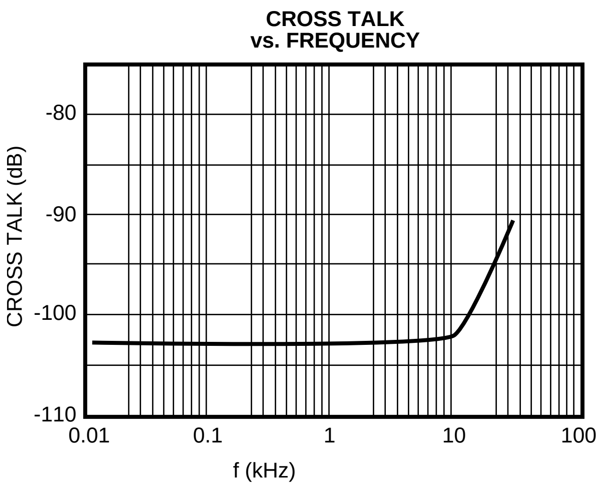


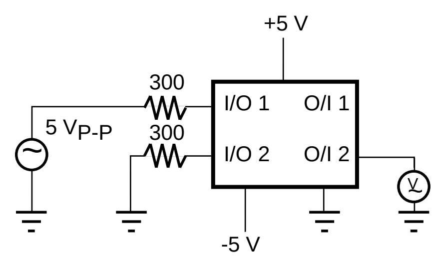
TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

T_A = 25 °C, unless otherwise specified.



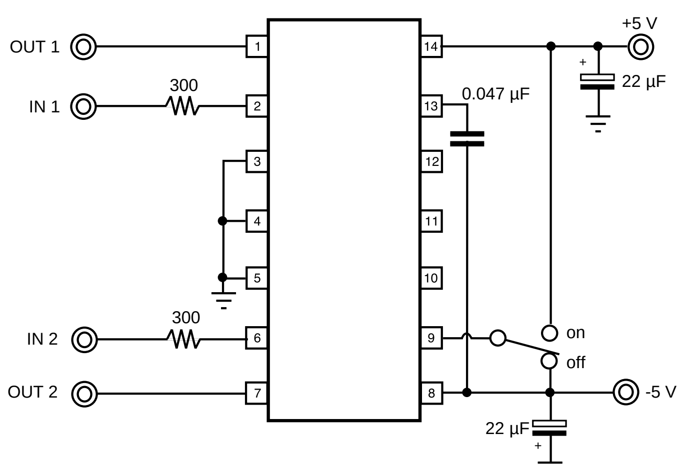




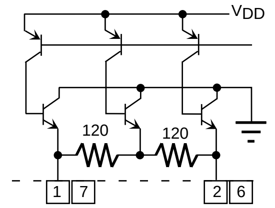
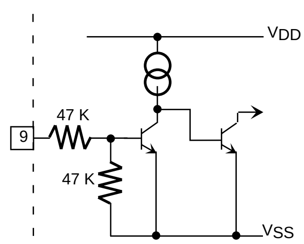
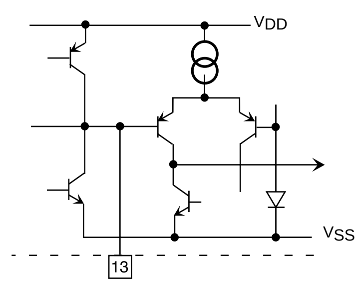


Cross Talk Test Circuit

STANDARD APPLICATION



TERMINAL VOLTAGE AND EQUIVALENT CIRCUIT

PIN NO.	SYMBOL	DC VOLTAGE	EQUIVALENT CIRCUIT	EXPLANATION
1 2 6 7	OUT/IN 1 IN/OUT 1 IN/OUT 2 OUT/IN 2	Floating / 0 V Floating / 0 V Floating / 0 V Floating / 0 V		Pin 1: Output for Pin 2. Pin 2: Input for Pin 1. Pin 6: Input for Pin 7. Pin 7: Output for Pin 6. Note 1
3 4 5	GND 1 GND 2 GND 3	0 V 0 V 0 V	GND pin.	Ground pin. Note 2
8	V_{SS}	-5.5 ~ -2.5 V	V_{SS} pin.	Negative Voltage Pin.
9	Control	-5.0 V		Control Pin for the Mute on/off.
10 11 12	NC NC NC	Floating Floating Floating		No Connection Pin. Note 3
13	Mute-C	-5.0 V / 3.2 V		Pin for Timing Capacitor for Attack/Release time. Note 4
14	V_{DD}	2.5 ~ 5.5 V	V_{DD} Pin.	Positive Voltage Pin.

Note 1: Even if the input and output became opposite, the action is the same.
Note 2: Connect all GND pins to the Ground.
Note 3: Although all NC pins are not connected internally to the IC, signals should not be externally applied to these pins.
Note 4: In the standard application a capacitor is connected between Pin 13 and V_{SS}. Attack is the term used to describe the action of changing the unit from ‘mute on’ to ‘mute off’.
The standard timing control capacitance is 0.047 μF.

TIMING-CHART AND ACTION TIME AT MUTE

Test conditions: V_{CC} = ±5 V, Timing Capacitor = 0.047 µF

The following values are typical characteristics; accordingly they are not guaranteed values.

ATTACK ACTION START (MUTE ON)

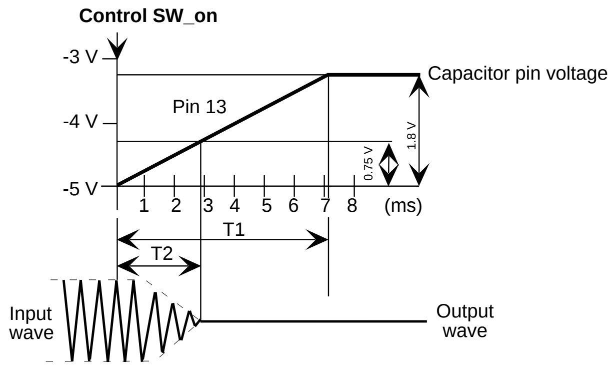
When the attack action is started ('mute on' is initiated), the capacitor on Pin 13 starts to charge. The voltage at the capacitor on Pin 13 rises by 1.8 V. The 1.8 V rise time can be calculated by the following equation:

$$T1 \approx \frac{\text{Capacitance X 1.8 V}}{\text{Charge Current}} = \frac{0.047\ \mu\text{F X 1.8 V}}{12\ \mu\text{A}} = 7.1\ \text{msec}$$

When the capacitor of Pin 13 rises by 1.8 V to -3.2 V as detected by the upper limit circuit, the mute action functions (V_{SS} + 1.8 V = -3.2 V). In this estimate, when the capacitor on Pin 13 has risen by 0.7 V to 0.8 V, the attenuation is approximately 90% of the final attenuation achieved. This results in the following calculation and timing chart.

$$T2 \approx \frac{0.047\ \mu\text{F X 0.75 V}}{12\ \mu\text{A}}$$

= 2.9 msec
This time is the attack time.



RELEASE ACTION START (MUTE OFF)

When the release action is started ('mute off' is initiated) the capacitor on Pin 13 starts to discharge. The voltage at the capacitor on Pin 13 falls to V_{SS} + 10 mV. This fall time can be calculated by the following equation:

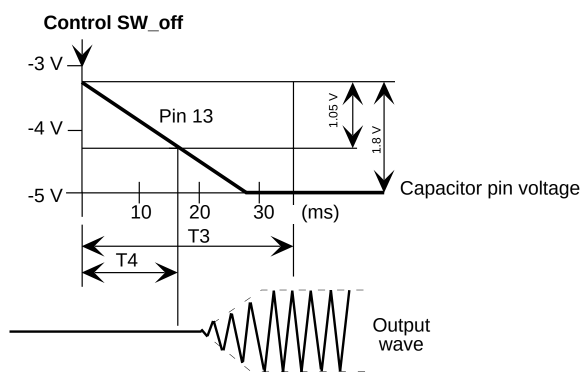
$$T3 \approx \frac{\text{Capacitance X 1.8 V}}{\text{Disharge Current}} = \frac{0.047\ \mu\text{F X 1.8 V}}{3\ \mu\text{A}} = 28\ \text{msec}$$

In this estimate, when the capacitor on Pin 13 has fallen to V_{SS} + 0.7 V to 0.8 V, the signal is restored to approximately 90% of its value. This results in the following calculation and timing chart:

$$T4 \approx \frac{0.047\ \mu\text{F X 1.05 V}}{3\ \mu\text{A}}$$

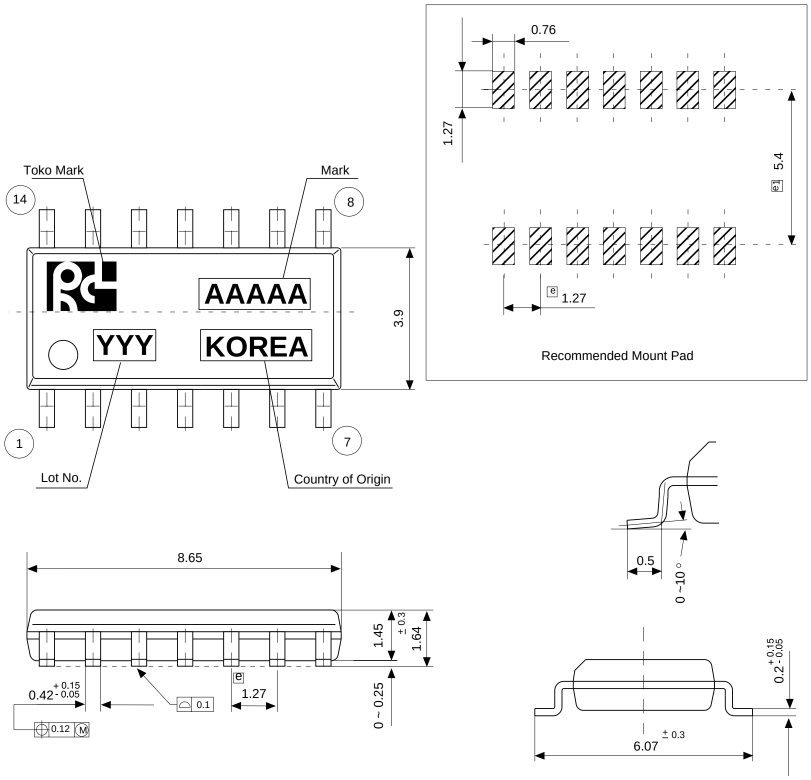
= 16 msec
This time is the release time.

Accordingly, the release action time is 12 msec
(T3 - T4 = 28 msec - 16 msec = 12 msec).



PACKAGE OUTLINE

SOP-14



Dimensions are shown in millimeters
Tolerance: x.x = ± 0.2 mm (unless otherwise specified)

Marking Information

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