



## M54133A

Preliminary

LINEAR INTEGRATED CIRCUIT

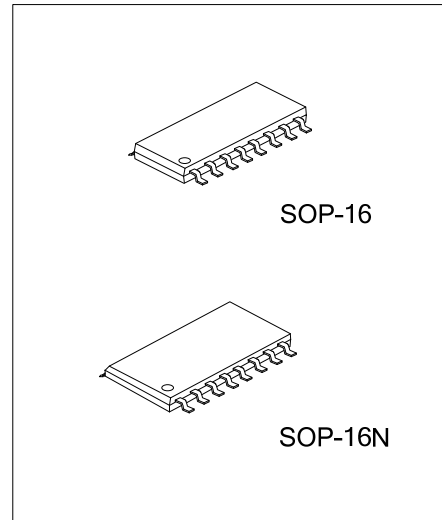
### EARTH LEAKAGE CURRENT DETECTOR

#### DESCRIPTION

The UTC **M54133A** is a semiconductor integrated circuit developed for use in high-speed earth leakage breakers incorporating functions to protect against voltage surges and inverter noise.

#### FEATURES

- \* Improvement of ability against unwanted tripping by lightning-surge and lightning impulse.  
Two times counting system adopted.
- \* Improvement of ability against unwanted tripping by inverter-noise.  
Built-in operational amplifier (of low current dissipation) for active low-pass filter.  
Improved high-frequency, high harmonic superposition performance
- \* Internal time delay function
- \* An external capacitor is used to set the delay time.
- \* High input sensitivity:  $V_T=11.5mV_{rms}$  Typ.
- \* Low-current dissipation (at  $R_{REF}=180k\Omega$ )  
In stand-by condition:  $I_S=610\mu A$  Typ.
- \* High stabilities design  
Adopt the circuits that is not affected by fluctuations of supply voltage/ambient temperature.

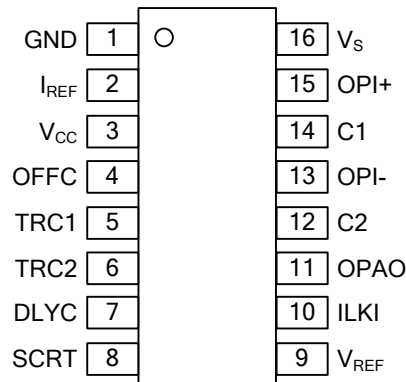


#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
M54133AL-S16-R	M54133AG-S16-R	SOP-16	Tape Reel
M54133AL-S16-T	M54133AG-S16-T	SOP-16	Tube
M54133AL-S16N-R	M54133AG-S16N-R	SOP-16N	Tape Reel
M54133AL-S16N-T	M54133AG-S16N-T	SOP-16N	Tube

<p>M54133AL-S16-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Halogen Free</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel, T: Tube</li> <li>(2) S16: SOP-16, S16N: SOP-16N</li> <li>(3) L: Lead Free, G: Halogen Free</li> </ul>
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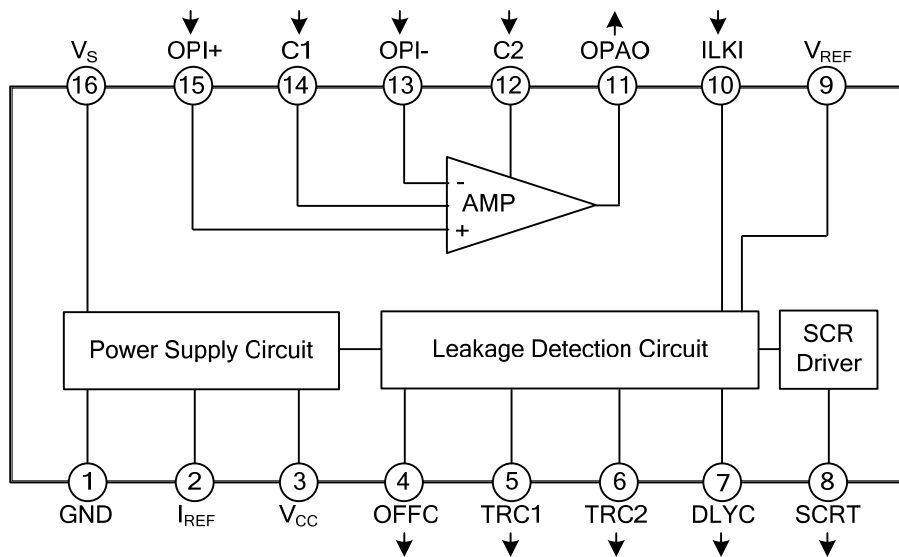
## ■ PIN CONFIGURATION



## ■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	GND	Grounding
2	I <sub>REF</sub>	Pin for connecting resistor that sets constant current for internal circuits; approx. 1.3 V.
3	V <sub>CC</sub>	Output pin of the internal constant-voltage circuit. Connect decoupling capacitor.
4	OFFC	Leakage input signal does not continue. Leakage is detected and SCR turn on. In these cases, this IC will be restored to the initial condition after a predetermined time. Connect capacitor that determines restore time.
5	TRC1	Pin for connecting capacitor that integrates signal output from discriminator of leak-signal input level.
6	TRC2	Pin for connecting capacitor to eliminate noise.
7	DLYC	Pin for connecting capacitor that sets delay time in case of using delay function.
8	SCRT	Output pin for driving a SCR.
9	V <sub>REF</sub>	Pin for providing input reference level of leakage detection. About 2.4V appears.
10	ILKI	Other input pin of leakage detection.
11	OPAO	Output pin of operational amplifier.
12	C2	Pin for connecting capacitor that prevents abnormal oscillations. Connect capacitor across IC at pins 11 and 12.
13	OPI-	Negative input pins of operational amplifier
14	C1	Pin for connecting capacitor that prevents noise from causing malfunction. Connect capacitors across IC at pins 13 and 14 and across IC at pins 15 and 14.
15	OPI+	Positive input pins of operational amplifier
16	VS	Power supply

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $T_A=25^\circ\text{C}$ , unless otherwise noted)

PARAMETER		SYMBOL	RATINGS	UNIT
Maximum Supply Voltage		$V_{S(\text{MAX})}$	15	V
Differential Input Voltage	OPI+ to OPI-	$V_{\text{ID}}$	-0.8~+0.8	V
Supply Current		$I_S$	4	mA
Differential Input Current	OPI+ to OPI-	$I_{\text{IOP}}$	-5~+5	mA
Input Current	$V_{\text{REF}}$ to GND	$I_{\text{IG}}$	10	mA
Power Dissipation		$P_D$	200	mW
Operating Ambient Temperature		$T_{\text{OPR}}$	-20~+85	$^\circ\text{C}$
Storage Temperature		$T_{\text{STG}}$	-55~+125	$^\circ\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage Range	$V_S$	7 ~ 12	V

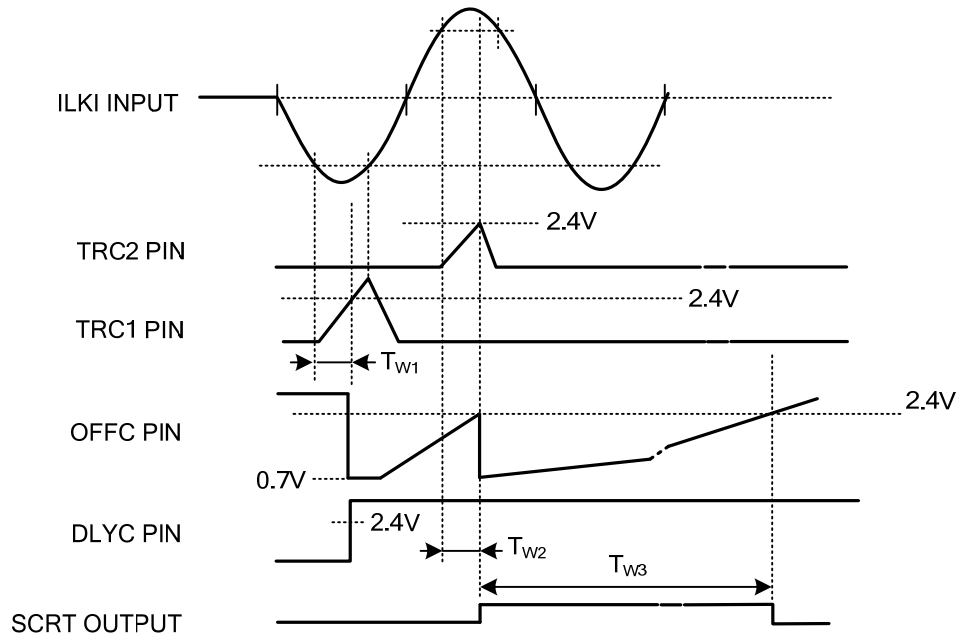
■ ELECTRICAL CHARACTERISTICS ( $T_A=25^\circ\text{C}$ ,  $V_S=9\text{V}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Power Supply Circuit</b>						
Maximum Supply Voltage	$V_{S(\text{MAX})}$	$I_S=4\text{mA}$		13.9	15	V
$V_{\text{CC}}$ -Pin Output Voltage	$V_{\text{CC}}$	$I_{\text{OH}}=-1\text{mA}$		5.2		V
Supply Current (In Standby)	$I_{S0}$		520	610	700	$\mu\text{A}$
Supply Current (While Detecting Leakage)	$I_{S1}$		560	650	740	$\mu\text{A}$
Supply Current (Immediately after Drive a SCR)	$I_{S2}$		480	570	660	$\mu\text{A}$
Ambient Temperature Dependence of $I_{S0}$		$T_A=-25\sim+85^\circ\text{C}$		-0.2		$\%/\text{C}$
<b>Operational Amplifier</b>						
Differential Input Clamp Voltage	$V_{\text{IC}}$	$I_{\text{DC}}=\pm 4\text{mA}$		$\pm 0.8$		V
OPOA-Pin "H" Output Current	$I_{\text{OH}}$			2.8		mA
OPOA-Pin "L" Output Current	$I_{\text{OL}}$			0.8		mA
Input Bias Current	$I_{\text{IC}}$			125		nA
Voltage Gain	$G_V$	$f=1\text{kHz}$		40		dB
Frequency Band Width	$B_W$	-3dB		6		kHz
Maximum Output Voltage	$V_O$			3.5		$V_{\text{PP}}$
Output Offset Voltage	$V_{\text{O(OFF)}}$			0		mV
<b>Leak Detector Circuit</b>						
$V_{\text{REF}}$ -Pin Output Voltage	$V_O$	$I_{\text{OH}}=-200\mu\text{A}$		2.4		V
$V_{\text{REF}}$ -GND Clamp Voltage	$V_{\text{RCL}}$	$I_{\text{RCL}}=5\text{mA}$		4.7		V
DC Input Voltage of Leakage Detection	$V_{\text{I(ON)}}$	With respect to $V_{\text{REF}}$		$\pm 14$ 0		mVd c
ILKI-Pin Input Bias Current	$I_{\text{IH}}$	$V_{\text{IN}}=V_{\text{REF}}$		220		nA
<b>3-ms Circuit</b>						
TRC1 threshold voltage	$V_{\text{TH1}}$			2.4		V
Accuracy of TRC1-Pin "H" Output Current	$E_{\text{IOH1}}$	$V_O=0\text{V}$ , $I_{\text{OH1}}=-7.6\mu\text{A}$	-10		+10	%
Accuracy of $T_{W1}$ pulse width	$E_{\text{TW1}}$	$C=0.01\mu\text{f}$ , $T_{W1}=3\text{ms}$	-15		+15	%
Ambient Temperature Dependence of $T_{W1}$		$T_A=-20\sim+85^\circ\text{C}$		0		$\%/\text{C}$

■ ELECTRICAL CHARACTERISTICS (Cont.)

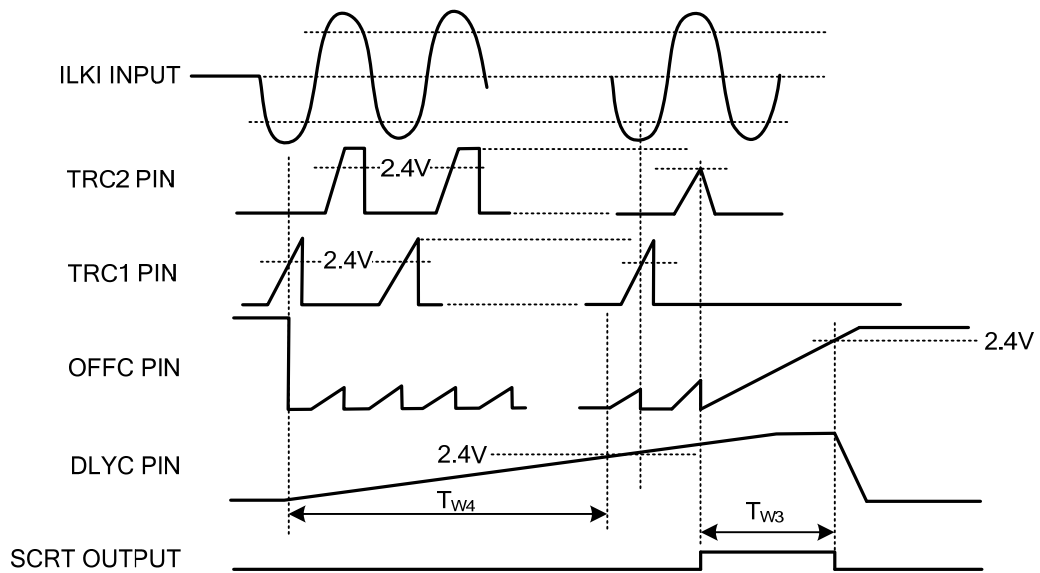
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>1-ms Circuit</b>						
TRC2 Threshold Voltage	$V_{TH2}$			2.4		V
Accuracy of TRC2-pin "H" Output Current	$E_{IOH2}$	$V_O=0V, I_{OH2}=-7.6\mu A$	-10		+10	%
Accuracy of TW2 Pulse Width	$E_{TW2}$	$C=0.0047\mu F, T_{W2}=1.5ms$	-15		+15	%
Ambient Temperature Dependence of $V_T$		$T_A=+25^\circ C \sim +85^\circ C$		-8.0		%
		$T_A=+25^\circ C \sim -20^\circ C$		+2.0		%
Ambient Temperature Dependence of $T_{w2}$		$T_A=-20 \sim +85^\circ C$		0		%/ $^\circ C$
Total AC Input Voltage of Leakage Detection	$V_T$	60Hz		11.5		mVrms
<b>Reset Circuit</b>						
OFFC Threshold Voltage	$V_{TH}$			2.4		V
Accuracy of OFFC-pin "H" Output Current	$E_{IOH}$	$V_O=0V, I_{OH}=-7.6\mu A$	-10		+10	%
Accuracy of Reset Time Pulse Width	$E_{TW3}$	$C=0.33\mu F, T_{W3}=75ms$	-30		+30	%
<b>Delay Circuit</b>						
DLYC Threshold Voltage	$V_{TH}$			2.4		V
Accuracy of DLYC-pin "H" Output Current	$E_{IOH}$	$V_O=0V, I_{OH}=-7.6\mu A$	-10		+10	%
Accuracy of Delay Timer Pulse Width	$E_{TW4}$	$C=1.0\mu F, T_{W4}=300ms$	-30		+30	%
<b>SCR Driver Circuit</b>						
SCRT-Pin "L" Output Voltage	$V_{OLB}$	$I_{OL}=200\mu A$		0.1	0.2	V
Supply Voltage for $I_{OH}$ Hold	$V_{S(OFF)}$			3.0	4.0	V
SCRT-Pin "H" Output Current	$I_{OHC}$	$V_O=8V$	$T_A=-20^\circ C$	-100	-160	$\mu A$
	$I_{OHN}$		$T_A=+20^\circ C$	-50	-130	$\mu A$
	$I_{OHH}$		$T_A=+85^\circ C$	-33	-100	$\mu A$

■ WITHOUT DELAY FUNCTION



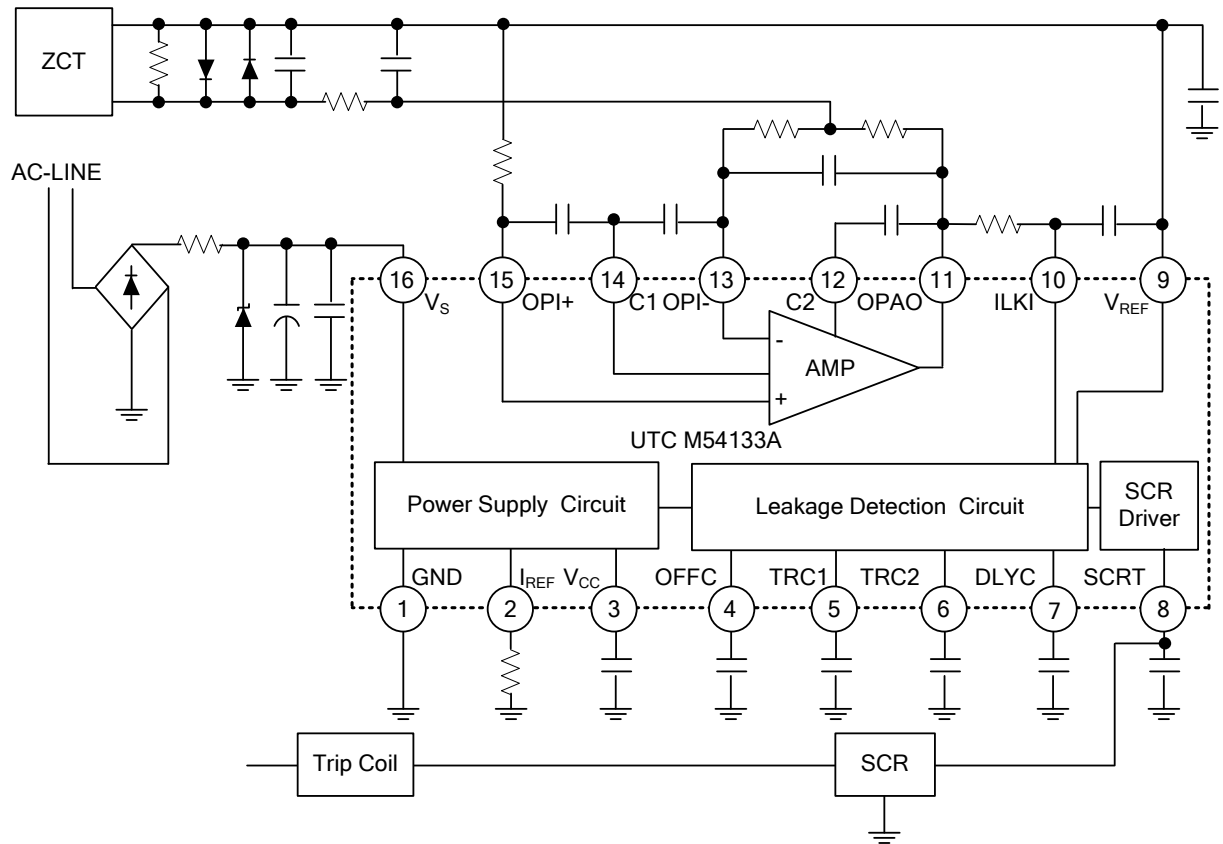
Without Delay Function

■ USING DELAY FUNCTION



Using Delay Function

■ TYPICAL APPLICATION CIRCUIT



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