



M54134

Preliminary

LINEAR INTEGRATED CIRCUIT

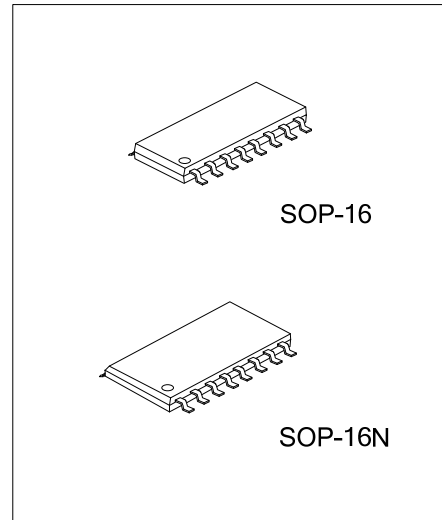
EARTH LEAKAGE CURRENT DETECTOR

DESCRIPTION

The UTC **M54134** is a semiconductor integrated circuit developed for use in high-speed earth leakage breakers incorporating functions to protect against voltage surges and inverter noise.

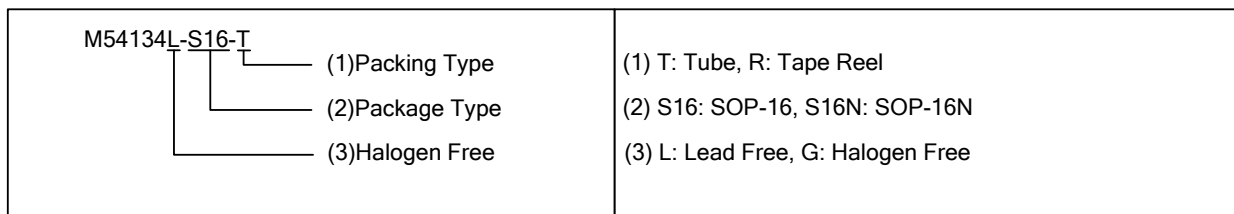
FEATURES

- * 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

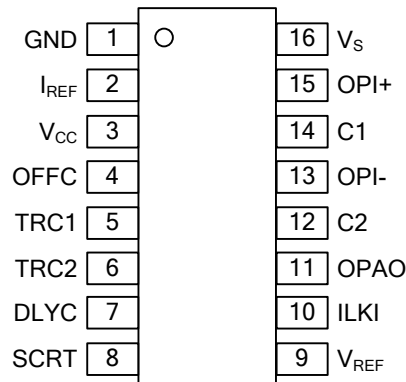
| Ordering Number | | Package | Packing |
|-----------------|----------------|---------|-----------|
| Lead Free | Halogen Free | | |
| M54134L-S16-T | M54134G-S16-T | SOP-16 | Tube |
| M54134L-S16-R | M54134G-S16-R | SOP-16 | Tape Reel |
| M54134L-S16N-T | M54134G-S16N-T | SOP-16N | Tube |
| M54134L-S16N-R | M54134G-S16N-R | SOP-16N | Tape Reel |



■ MARKING INFORMATION

| PACKAGE | MARKING |
|-------------------|---|
| SOP-16 SOP-16N | <p>UTC □□□□ → Date Code M54134 □ → L: Lead Free □□ → G: Halogen Free ● → Lot Code</p> |

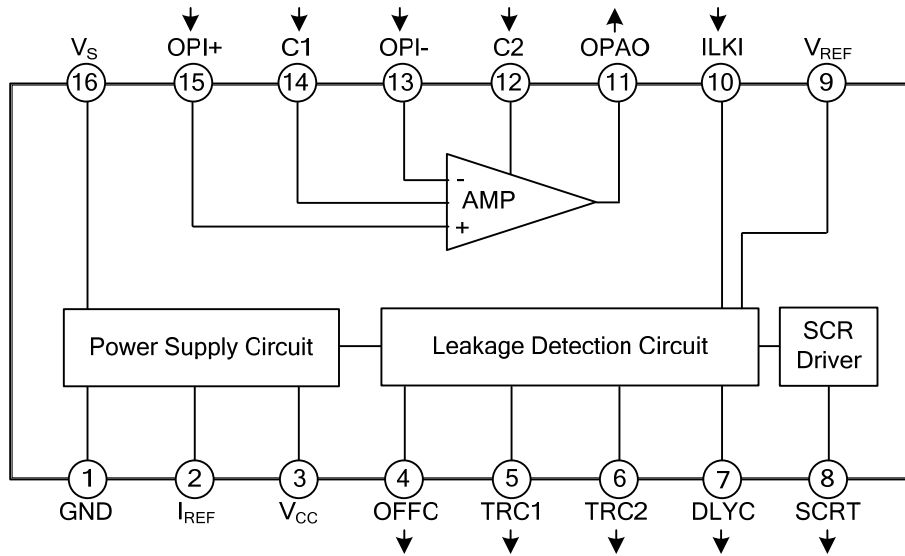
■ PIN CONFIGURATION



■ PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|------------------|---|
| 1 | GND | Grounding |
| 2 | I _{REF} | Pin for connecting resistor that sets constant current for internal circuits; approx. 1.3 V. |
| 3 | V _{CC} | 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 _{REF} | 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_{ID} | -0.8~+0.8 | V |
| Supply Current | | I_S | 4 | mA |
| Differential Input Current | OPI+ to OPI- | I_{IOP} | -5~+5 | mA |
| Input Current | V_{REF} to GND | I_{IG} | 10 | mA |
| Power Dissipation | | P_D | 200 | mW |
| Operating Ambient Temperature | | T_{OPR} | -20~+85 | $^\circ\text{C}$ |
| Storage Temperature | | T_{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 |

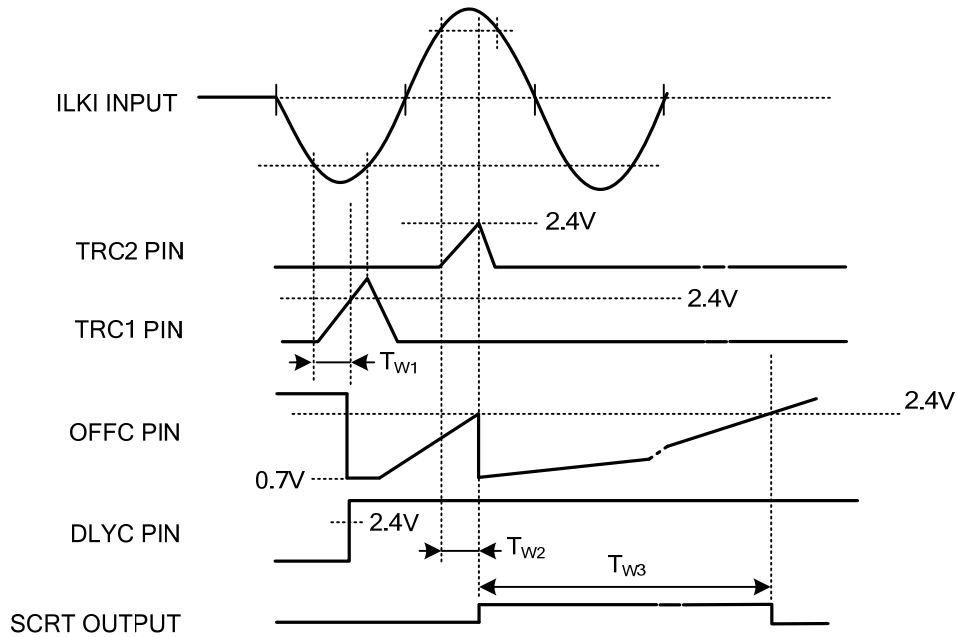
■ ELECTRICAL CHARACTERISTICS ($T_A=25^\circ\text{C}$, $V_S=9\text{V}$, unless otherwise noted)

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

■ ELECTRICAL CHARACTERISTICS (Cont.)

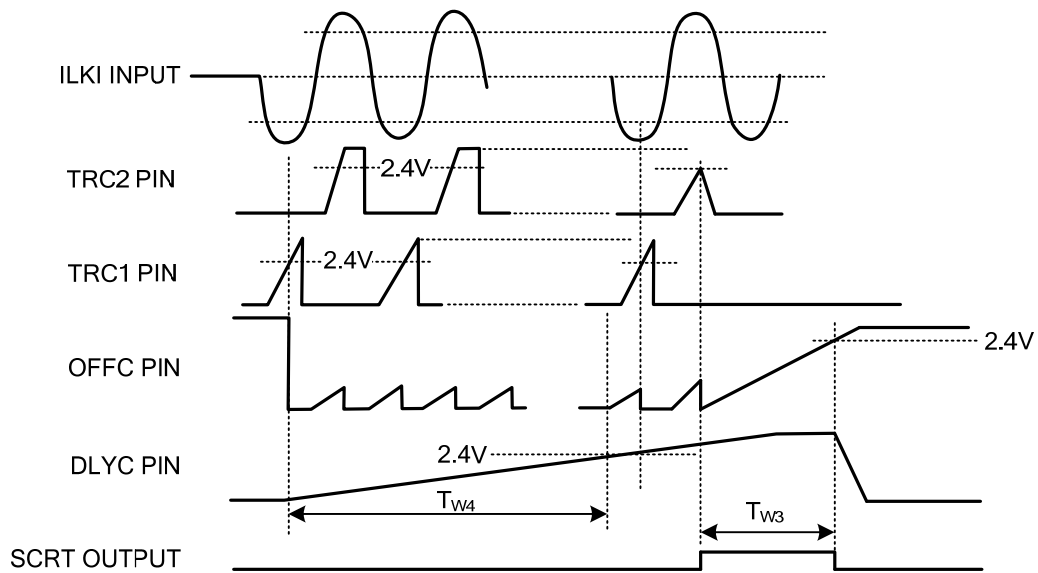
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--------------|------------------------------------|-------------------|------|------|---------------|
| 1-ms Circuit | | | | | | |
| TRC2 Threshold Voltage | V_{TH2} | | | 2.4 | | V |
| Accuracy of TRC2-pin "H" Output Current | E_{IOH2} | $V_O=0V, I_{OH2}=-7.6\mu A$ | -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 |
| Reset Circuit | | | | | | |
| 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 | % |
| Delay Circuit | | | | | | |
| 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 | % |
| SCR Driver Circuit | | | | | | |
| SCRT-Pin "L" Output Voltage | V_{OL8} | $I_{OL}=200\mu A$ | | 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 | μA |
| | I_{OHN} | | $T_A=+20^\circ C$ | -50 | -130 | μA |
| | I_{OHH} | | $T_A=+85^\circ C$ | -33 | -100 | μA |

■ WITHOUT DELAY FUNCTION



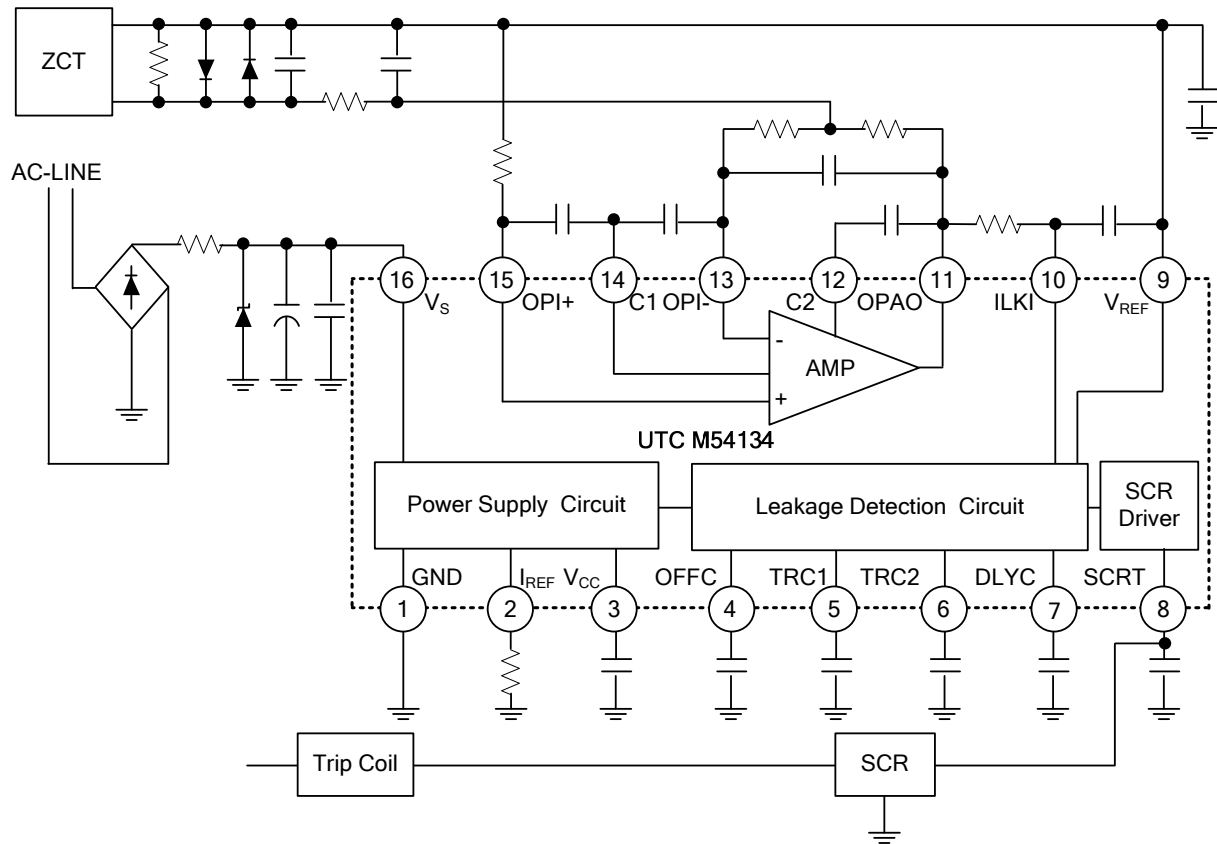
Without Delay Function

■ USING DELAY FUNCTION



Using Delay Function

■ TYPICAL APPLICATION CIRCUIT



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