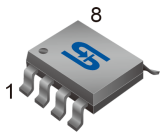
TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

# TS103

## Dual Operational Amplifiers And Voltage Reference

**SOP-8**




**Pin assignment:**

1. Output A
2. Input A (-)
3. Input A (+) / Vka
4. Gnd
8. Vcc
7. Output B
6. Input B (-)
5. Input B (+)

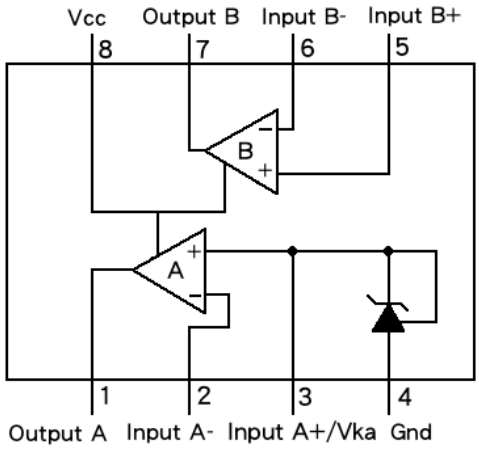
## General Description

The TS103 is a monolithic IC specifically designed to control the output current and voltage levels of switch mode battery chargers and power supplies. The device contains two operational amplifiers and a precision shunt regulator. Op Amp 1 is designed for voltage control, whose non-inverting input internally connects to the output of the shunt regulator. Op Amp 2 is for current control with both inputs uncommitted. The IC offers the power converter designer a control solution that features increased precision with a corresponding reduction in system complexity and cost.

## Features

- Input Offset Voltage: 0.5mV
- Supply Current: 250uA per OP AMP @ 5V
- Unity Gain Bandwidth: 1MHz
- Output Voltage Swing: 0~(Vcc – 1.5) V
- Power Supply Voltage: 3~18V
- Fixed Output Voltage Reference: 2.5V±1%
- Sink Current Capability from 0.2~80mA

## Block Diagram




## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TS103CS RLG | SOP-8 | 2.5Kpcs / 13” Reel |
| TS103ACS RLG | SOP-8 | 2.5Kpcs / 13” Reel |

**Note:** “G” denote for Halogen Free Product

## Absolute Maximum Rating

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Power Supply Voltage ($V_{CC}$ to GND) | $V_{CC}$ | 20 | V |
| Op Amp 1 and 2 Input Voltage Range (Pins 2,5,6) | $V_{IN}$ | -0.3 to $V_{CC}$ +0.3 | V |
| Op Amp 2 Input Differential Voltage (Pins 5,6) | $V_{ID}$ | 20 | V |
| Voltage Reference Cathode Current (Pin 3) | $I_K$ | 100 | mA |
| Power Dissipation | $P_D$ | 500 | mW |
| Storage Temperature Range | $T_{STG}$ | -65 to 150 | °C |
| ESD Protection Voltage (Machine Model) | -- | ≥200 | V |

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings " may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings " for extended periods may affect device reliability.

## Recommended Operating Conditions

| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| Supply Voltage | 3 | 18 | V |
| Ambient Temperature | -40 | 85 | °C |

# TS103
## Dual Operational Amplifiers And Voltage Reference

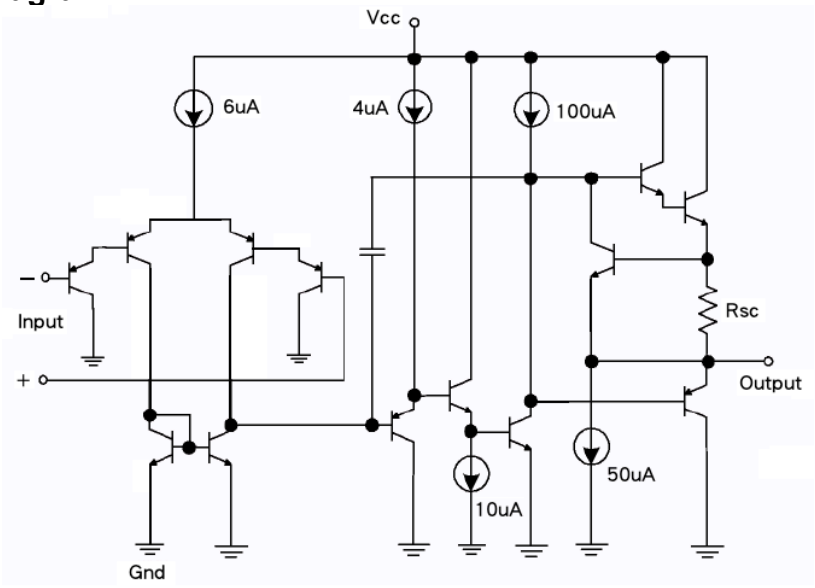
**Electrical Characteristics** (Operating Conditions: $V_{CC}$ = +5V, TA= 25°C unless otherwise specified)

| Parameters | | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Total Supply Current, excluding Current in Voltage Reference | | $V_{CC}$ = 5V, no load, -40°C ≤$T_A$ ≤85°C | -- | 0.5 | 0.8 | mA |
| | | $V_{CC}$ = 18V, no load, -40°C≤ $T_A$ ≤85°C | -- | 0.6 | 1.2 | |
| **Voltage Reference Section** | | | | | | |
| Reference Voltage | TS103 | $I_{KA}$ = 10mA | 2.475 | 2.500 | 2.525 | V |
| | | $I_{KA}$ = 10mA @ -40°C ≤$T_A$ ≤85°C | 2.45 | 2.500 | 2.55 | |
| | TS103A | $I_{KA}$ = 10mA | 2.490 | 2.500 | 2.510 | |
| | | $I_{KA}$ = 10mA @ -40°C ≤$T_A$ ≤85°C | 2.475 | 2.500 | 2.525 | |
| Reference Voltage Deviation Over Full Temperature Range | | $I_{KA}$ = 10mA, $T_A$=-40 to 85°C | --<br>-- | 5<br>5 | 24<br>17 | mV |
| Minimum Cathode Current for Regulation | | | -- | 0.2 | 1.0 | mA |
| Dynamic Impedance | | $V_{CC}$ = 1.0 to 80mA, f<1kHz | | 0.3 | 0.5 | Ω |
| **OP AMP 1 Section** ($V_{CC}$= 5V, $V_O$= 1.4V, $T_A$= 25°C, unless otherwise noted) | | | | | | |
| Input Offset Voltage | | $T_A$ = 25°C (TS103) | -- | 0.5 | 3 | mV |
| | | $T_A$ = 25°C (TS103A) | -- | 0.5 | 2 | |
| | | $T_A$ = -40 to 85°C | -- | -- | 5 | |
| Input Offset Voltage Temperature Drift | | $T_A$ = -40 to 85°C | -- | 7 | -- | μV/°C |
| Input Bias Current (Inverting Input Only) | | $T_A$ = 25°C | -- | 20 | 150 | nA |
| Large Signal Voltage Gain | | $V_{CC}$= 15V, $R_L$ = 2kΩ, $V_O$ = 1.4 to 11.4V | 85 | 100 | -- | dB |
| Power Supply Rejection Ratio | | $V_{CC}$ = 5 to l8V | 70 | 90 | -- | dB |
| Output Current | Source | $V_{CC}$ = 15V, $V_{ID}$ = 1V, $V_O$ = 2V | 20 | 40 | -- | mA |
| | Sink | $V_{CC}$ = 15V, $V_{ID}$ = -1V, $V_O$ = 2V | 10 | 20 | -- | mA |
| Output Voltage Swing (High) | | $V_{CC}$= 18V, $R_L$ = 10kΩ, $V_{ID}$ = 1V | 16 | 16.5 | -- | V |
| Output Voltage Swing (Low) | | $V_{CC}$= 18V, $R_L$ = 10kΩ, $V_{ID}$ = -1V | -- | 17 | 100 | mV |
| Slew Rate | | $V_{CC}$= 18V, $R_L$ = 2kΩ, $A_V$ = 1, $V_{IN}$ = 0.5 to 2V, $C_L$ = 100pF | 0.2 | 0.5 | -- | V/μs |
| Gain Bandwidth Product | | $V_{CC}$= 18V, $R_L$ = 2kΩ, $C_L$ = 100pF $V_{IN}$ = 10mV, f = 100kHz | 0.5 | 1 | -- | MHz |

## Electrical Characteristics (Operating Conditions: $V_{CC}$ = +5V, $T_A$= 25°C unless otherwise specified)

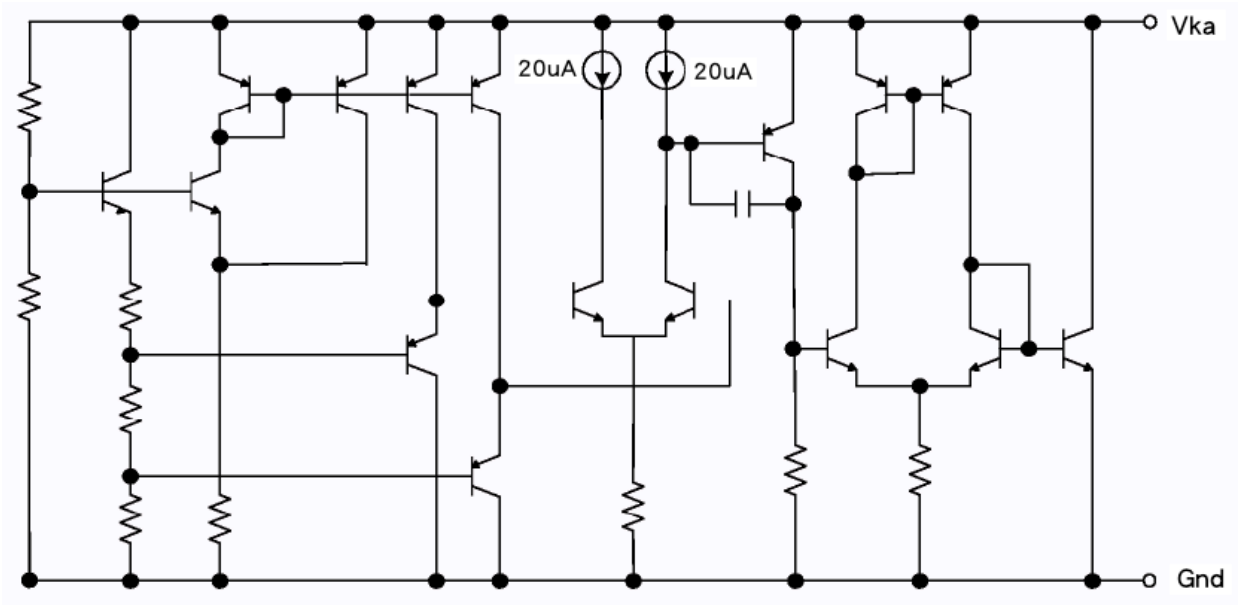
| Parameters | | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OP AMP 2 Section** ($V_{CC}$= 5V, $V_O$= 1.4V, $T_A$= 25°C, unless otherwise noted) | | | | | | |
| Input Offset Voltage | | $T_A$ = 25°C (TS103) | -- | 0.5 | 3 | mV |
| | | $T_A$ = 25°C (TS103A) | -- | 0.5 | 2 | |
| | | $T_A$ = -40 to 85°C | -- | -- | 5 | |
| Input Offset Voltage Temperature Drift | | $T_A$ = -40 to 85°C | -- | 7 | -- | µV/°C |
| Input Bias Current | | $T_A$ = 25°C | -- | 20 | 150 | nA |
| Input Voltage Range | | $V_{CC}$ = 0~18V | 0 | 00 | Vcc-1.5 | V |
| Large Signal Voltage Gain | | $V_{CC}$ = 15V, $R_L$ = 2kΩ, $V_O$ = 1.4 to 11.4V | 85 | 100 | -- | dB |
| Power Supply Rejection Ratio | | $V_{CC}$ = 5 to l8V | 70 | 90 | -- | dB |
| Output Current | Source | $V_{CC}$ = 15V, $V_{ID}$ = 1V, $V_O$ = 2V | 20 | 40 | -- | mA |
| | Sink | $V_{CC}$ = 15V, $V_{ID}$ = -1V, $V_O$ = 2V | 10 | 20 | -- | mA |
| Output Voltage Swing (High) | | $V_{CC}$ = 18V, $R_L$ = 10kΩ, $V_{ID}$ = 1V | 16 | 16.5 | -- | V |
| Output Voltage Swing (Low) | | $V_{CC}$ = 18V, $R_L$ = 10kΩ, $V_{ID}$ = -1V | -- | 17 | 100 | mV |
| Slew Rate | | $V_{CC}$ = 18V, $R_L$ = 2kΩ, $A_V$ = 1, $V_{IN}$ = 0.5 to 2V, $C_L$ = 100pF | 0.2 | 0.5 | -- | V/µs |
| Gain Bandwidth Product | | $V_{CC}$ = 18V, $R_L$ = 2kΩ, $C_L$ = 100pF $V_{IN}$ = 10mV, f = 100kHz | 0.5 | 1 | -- | MHz |

## Function Block Diagram



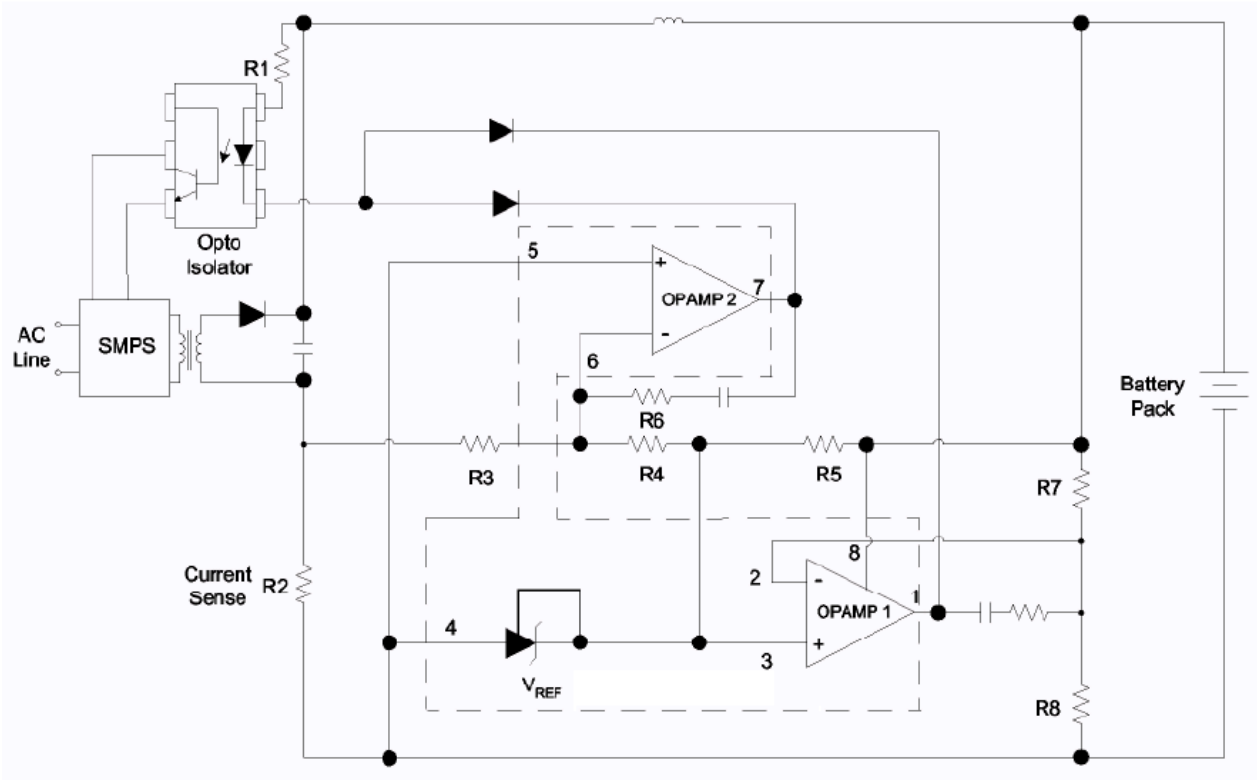

**OP AMP Function Block Diagram (Each Amplifier)**

## Function Block Diagram (Continue)

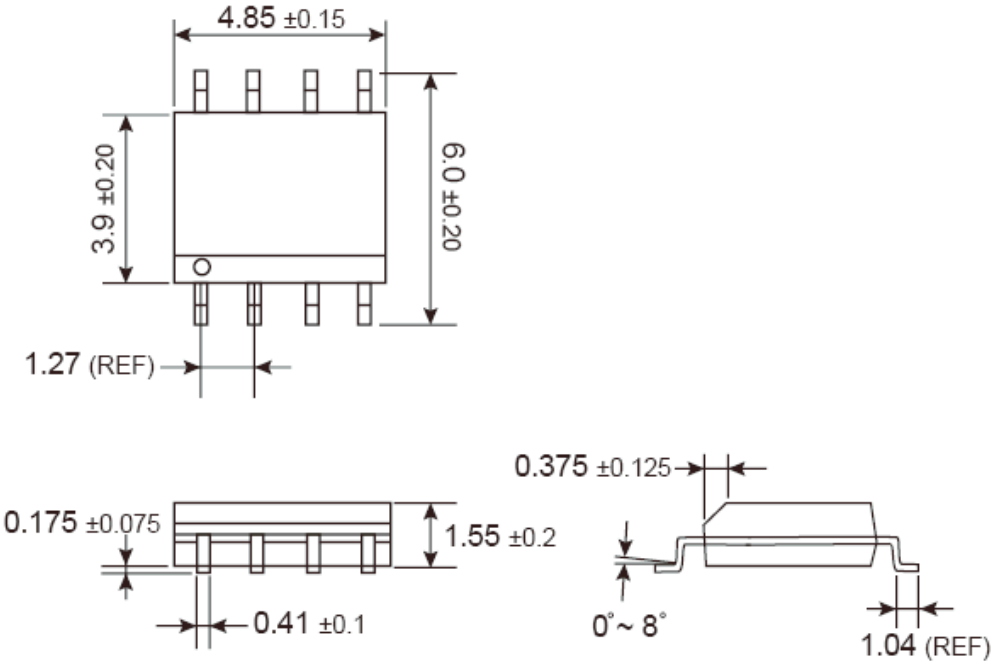



**Voltage Reference Function Block Diagram**

## Typical Application Circuit

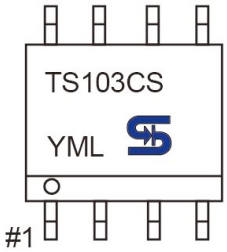


## SOP-8 Mechanical Drawing




Unit: Millimeters

## Marking Diagram




**Y** = Year Code
**M** = Month Code for Halogen Free Product
(**O**=Jan, **P**=Feb, **Q**=Mar, **R**=Apl, **S**=May, **T**=Jun, **U**=Jul, **V**=Aug, **W**=Sep, **X**=Oct, **Y**=Nov, **Z**=Dec)
**L** = Lot Code

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