# High Slew Rate, High Current Drive, and Rail to Rail Operation Amplifier

## General Description

The uS5506 contains two independent, high slew rate and high current drive rail to rail operation amplifiers. The uS5506 operates over a wide range of voltage 4.5V~20V with very low bias current.

uS5506 provides peak output current to 600mA drive rail to rail output and fast slew rate to 50V/us. Other features include over-temperature protection, over-current protection, and output short protection. They provide complete protection for system application. The uS5506 is available in MSOP-8L and PMSOP-8L packages.

## Ordering Information

| Order Number | Package Type | Top Marking |
|---|---|---|
| uS5506PRA8 | MSOP-8L | uS5506P |
| uS5506PRU8 | PMSOP-8L | uS5506P |

Note:
(1) uPI products are compatible with the current IPC/ JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

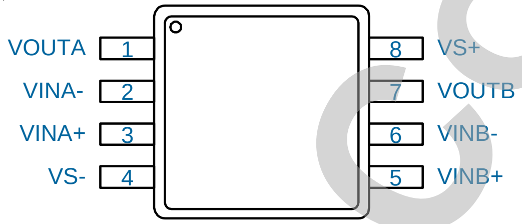
## Features

- **4.5V to 20V Input Voltage Range**
- **600mA Peak Output Current**
- **Rail to Rail Output**
- **50V/uS Slew Rate**
- **30MHz Bandwidth**
- **1.2mA Quiescent Current Per Channel**
- **Over Current Protection**
- **Over Temperature Protection**
- **Output Short Protection**
- **MSOP-8L and PMSOP-8L Packages**
- **RoHS Compliant and Halogen Free**

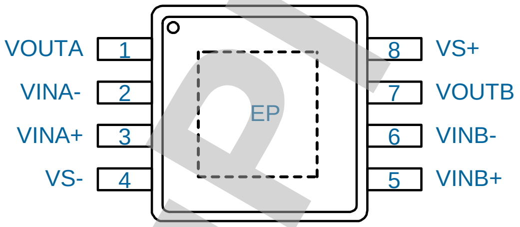
## Applications

- **TFT-LCD VCOM Buffer**
- **TFT-LCD Gamma Buffer**

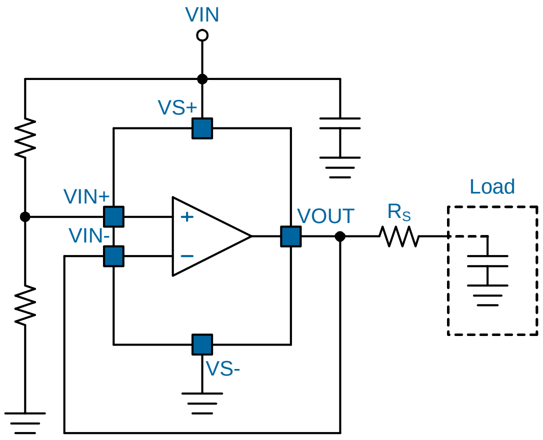
## Pin Configuration & Typical Application Circuit



MSOP-8L



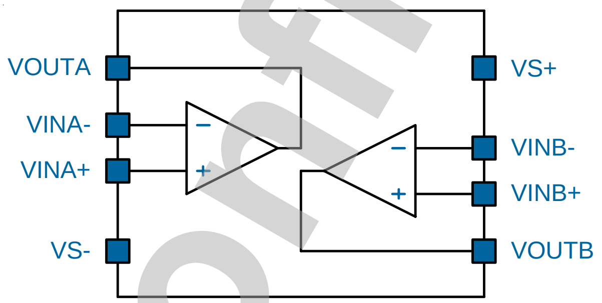
PMSOP-8L



## Functional Pin Description

| No. | Pin Name | Pin Function |
|---|---|---|
| 1 | VOUTA | **Output for Amplifier-A.** |
| 2 | VINA- | **Negative Input for Amplifier-A.** |
| 3 | VINA+ | **Positive Input for Amplifier-A.** |
| 4 | VS- | **Negative Supply Input.** |
| 5 | VINB+ | **Positive Input for Amplifier-B.** |
| 6 | VINB- | **Negative Input for Amplifier-B.** |
| 7 | VOUTB | **Output for Amplifier-B.** |
| 8 | VS+ | **Positive Supply Input.** |
| EP | | **Exposed Pad.** |

## Functional Block Diagram



## *Functional Description*

The uS5506 includes 2-Channel independent operation amplifiers. It has fast slew rate to 50V/uS and high current drive to 600mA peak current. It can operate within wide range from 4.5~20V and rail to rail output. It is suitable for TFT-LCD gamma and VCOM buffer voltage.

The uS5506 features over-current protection, over-temperature, and output short protection function. These features supply complete protection for the TFT-LCD panel application. When VIN = VS+ / 2, the output current will be limited to 600mA for m = normal operation. If output shorts to VS-, the over-current protection machine will keep regulating power dissipation to prevent power bus being burnt out.

uS5506 has thermal protection function to prevent the excessive power dissipation from overheating. When the junction temperature exceeds 150$^{O}$C, it will disable normal operation to lower chip operation temperature.

## Absolute Maximum Rating

Supply Voltage, VS+ to VS- (Note 1) ---------- -0.3V to +22.5V
Input Voltage ---------- (VS-)-0.5V to (VS+) + 0.5V
Storage Temperature Range ---------- -65°C to +150°C
Junction Temperature ---------- 150°C
Lead Temperature (Soldering, 10 sec) ---------- 260°C
ESD Susceptibility (Note 2)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

## Thermal Information

Package Thermal Resistance (Note 3)
  MSOP-8L $\theta_{JA}$ ---------- 160°C/W
  MSOP-8L $\theta_{JC}$ ---------- 40°C/W
  PMSOP-8L $\theta_{JA}$ ---------- 86°C/W
  PMSOP-8L $\theta_{JC}$ ---------- 30°C/W
Power Dissipation, $P_D$ @ $T_A = 25°C$
  MSOP-8L ---------- 0.625W
  PMSOP-8L ---------- 1.16W

## Recommended Operation Conditions

Operating Junction Temperature Range (Note 4) ---------- -40°C to +125°C
Operating Ambient Temperature Range ---------- -40°C to +85°C

**Note 1.** Stresses listed as the above “ Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

**Note 2.** Devices are ESD sensitive. Handling precaution recommended.

**Note 3.** $\theta_{JA}$ is measured in the natural convection at $T_A = 25°C$ on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

**Note 4.** The device is not guaranteed to function outside its operating conditions.

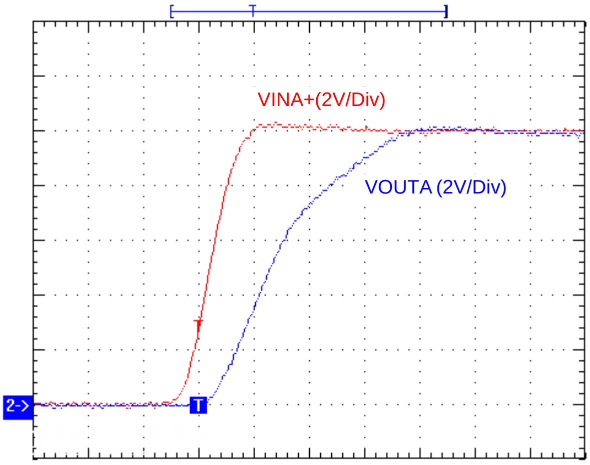
## Electrical Characteristics

(VS+ = 20V,VS- = 0V, $V_L$ = 10kΩ, $C_L$ = 10pFΩ, $T_A$ = 25°C, unless otherwise specified)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Supply Input** | | | | | | |
| Input Offset Voltage | $V_{OS}$ | $V_{CM}$ = 10V | -- | +/-2 | 15 | mV |
| Averaged Temperature Coefficient of Input Offset Voltage | $TCV_{OS}$ | | -- | 5 | -- | uV/°C |
| Input Bias Current | $I_{IB}$ | $V_{CM}$ = 10V | -- | 2 | 50 | nA |
| Input Impedance | $R_{IN}$ | | -- | 1 | -- | GΩ |
| Input Capacitance | $C_{IN}$ | | -- | 1.5 | -- | pF |
| Common Mode Input Range | CMIR | | -0.5 | -- | +20.5 | V |
| Common Mode Rejection Ratio | CMRR | +0.5V < $V_{OUT}$ < +19.5V(No Load) | 50 | 70 | -- | dB |
| Open Loop Gain | $A_{VOL}$ | +0.5V < $V_{OUT}$ < +19.5V(No Load) | 50 | 70 | -- | dB |
| Output Swing Low | $V_{OL}$ | $I_L$ = -5mA | -- | 100 | 150 | mV |
| Output Swing High | $V_{OH}$ | $I_L$ = +5mA | 19.85 | 19.9 | -- | V |
| Peak Output Current | $I_{OUT}$ | average current of peak source & sink current | -- | +/-600 | -- | mA |
| Continuous Output Current | | $V_{OUT}$ = 10V | 60 | 80 | -- | mA |
| Power Supply Rejection Ratio | PSRR | +6V < VS+ < +20V | 60 | 80 | -- | dB |
| Supply Current(Per Channel) | $I_S$ | No Load | -- | 1.2 | -- | mA |
| Slew Rate | SR | +0.5V < $V_{OUT}$ < +19.5V, 20% to 80% (average of rising and falling edge slew rate) | -- | 50 | -- | V/uS |
| Setting to +/-0.1%($A_V$ = +1) | ts | $V_O$ = 2.0V step @ $C_L$ = 0pF | -- | 200 | -- | nS |
| -3dB Bandwidth | BW | No Load | -- | 30 | -- | MHz |
| Gain Bandwidth Product | GBWP | No Load | -- | 24 | -- | MHz |
| Phase Margin | PM | No Load | -- | 50 | -- | deg |
| Channel Separation | CHS | f = 5MHz | -- | 90 | -- | dB |
| Over-Temperature Threshold | $T_{OTP}$ | | -- | 150 | -- | °C |
| Over-Temperature Hysteresis | $T_{OTP\_HYS}$ | | -- | 20 | -- | °C |

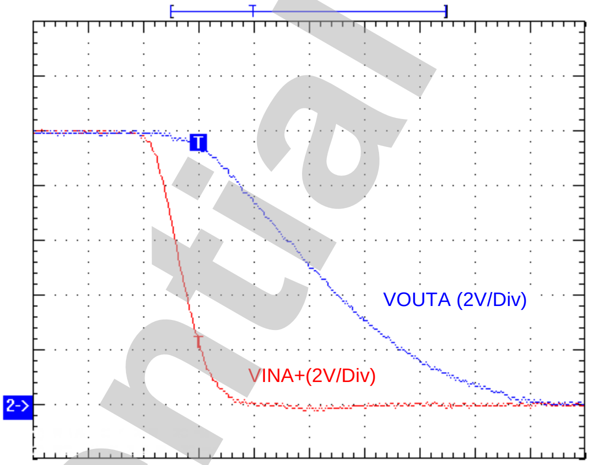
## Typical Operation Characteristics

### Slew Rate (Rising)



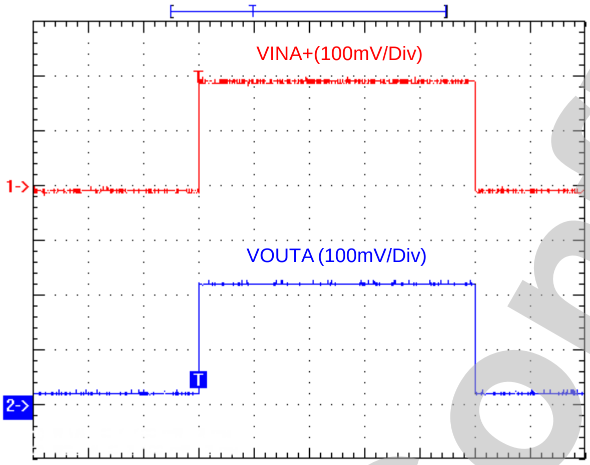
Time: 20ns/Div
VS+ = 20V, VINA+ = 10V, No Load

### Slew Rate (Falling)



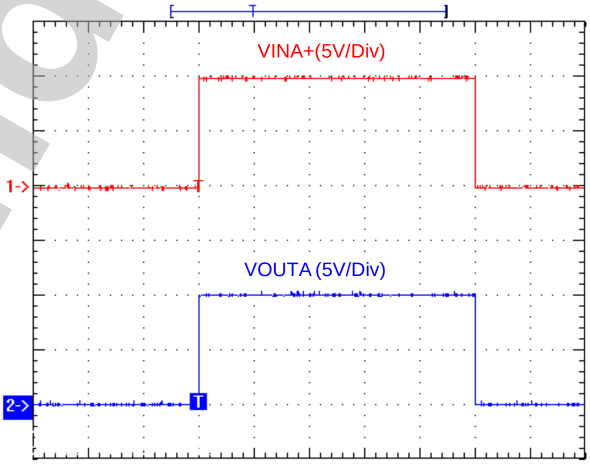
Time: 20ns/Div
VS+ = 20V, VINA+ = 10V, No Load

### Small Signal Transient Response



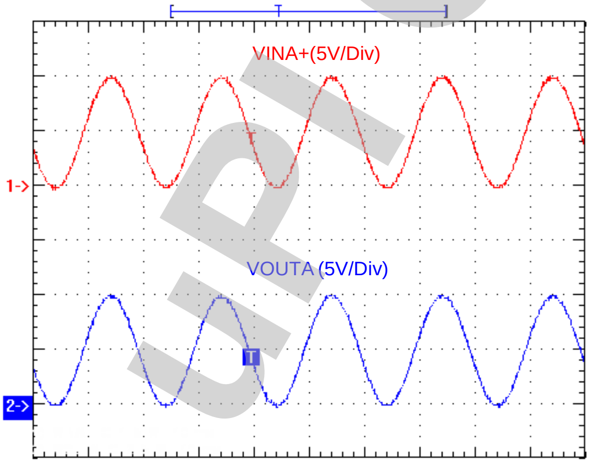
Time: 2ms/Div
VS+ = 20V, VINA+ = 200mV, No Load

### Large Signal Transient Response



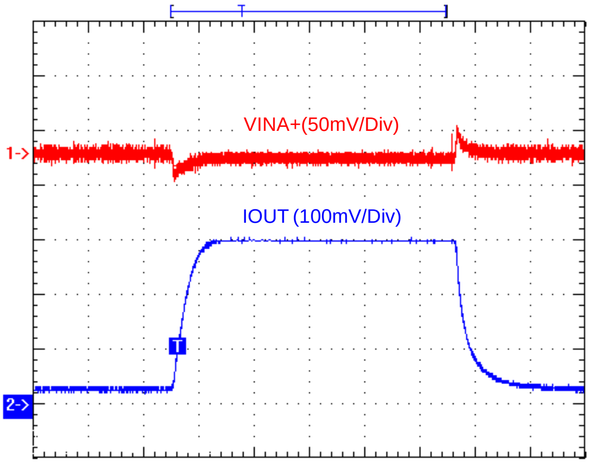
Time: 2ms/Div
VS+ = 20V, VINA+ = 10V, No Load

### Rail-to-Rail



Time: 10ms/Div
VS+ = 10V, VINA+ = 10V, No Load

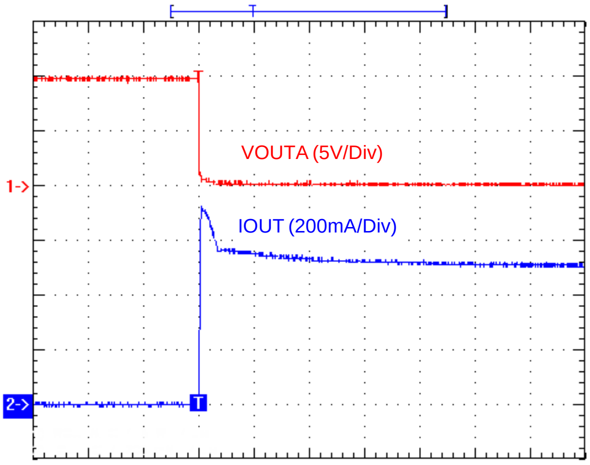
### Load Transient Response



Time: 40us/Div
VS+ = 20V, VINA+ = 10V, Load = 300mA

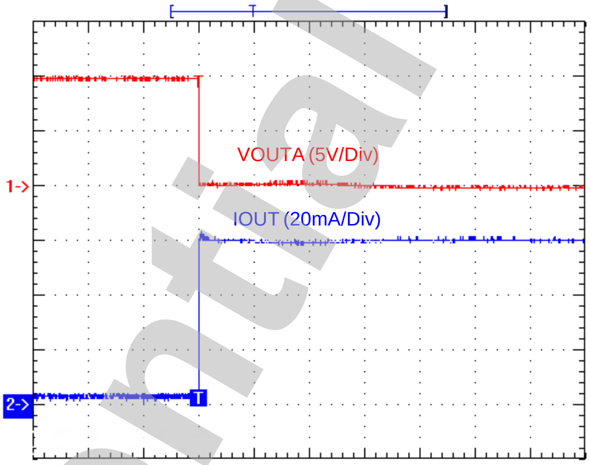
## Typical Operation Characteristics

### Output Peak Current



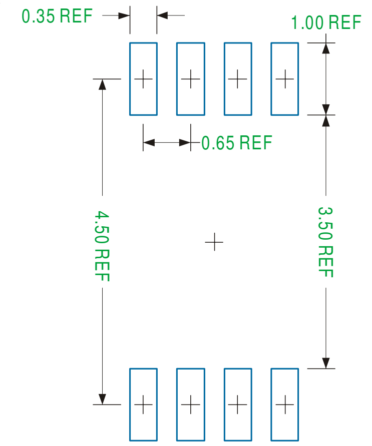
Time: 4us/Div
VS+ = 20V, VINA+ = 10V, VOUTA short to GND

### Output Continue Current

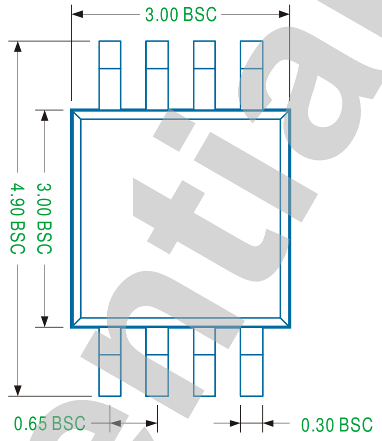


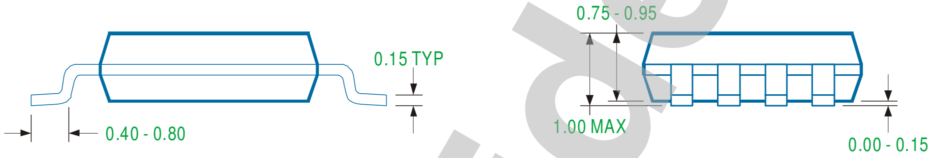
Time: 4us/Div
VS+ = 20V, VINA+ = 10V, VOUTA short to GND

## MSOP-8L



Recommended Solder Pad Layout

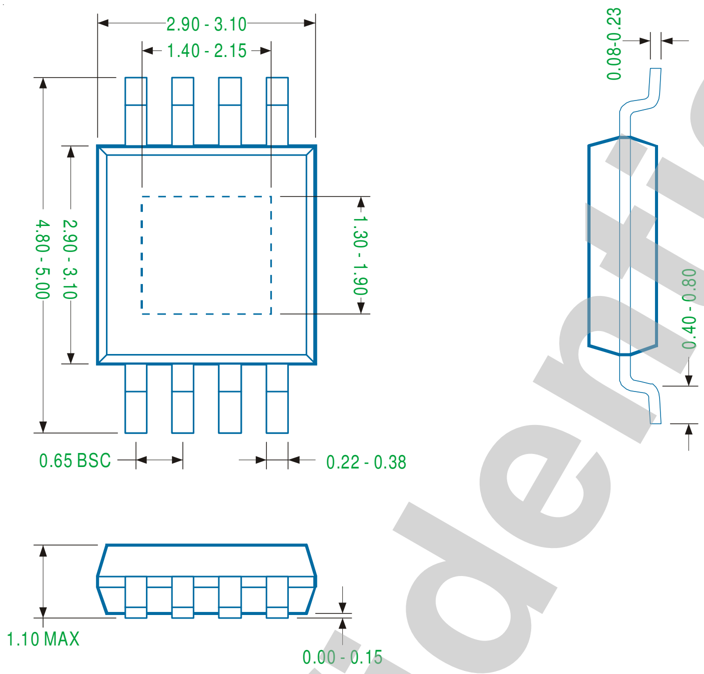




Note

1. Package Outline Unit Description:
   BSC: Basic. Represents theoretical exact dimension or dimension target
   MIN: Minimum dimension specified.
   MAX: Maximum dimension specified.
   REF: Reference. Represents dimension for reference use only. This value is not a device specification.
   TYP. Typical. Provided as a general value. This value is not a device specification.
2. Dimensions in Millimeters.
3. Drawing not to scale.
4. These dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm.

## PMSOP-8L



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