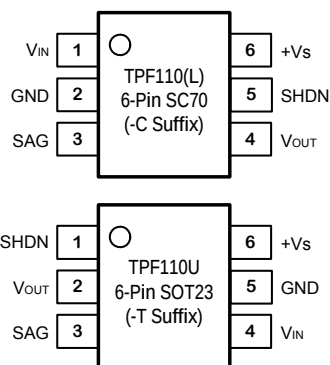


## Order Information

| Order Number | Marking Information  | Operating Temperature Range | Package      | Transport Media, Quantity  |
|--------------|----------------------|-----------------------------|--------------|----------------------------|
| TPF110-CR    | F0YW <sup>(1)</sup>  | -40 to 85°C                 | 6 Lead SC70  | 7" Tape and Reel, 3,000pcs |
| TPF110U-TR   | F0UYW <sup>(1)</sup> | -40 to 85°C                 | 6 Lead SOT23 | 7" Tape and Reel, 3,000pcs |
| TPF110L-CR   | F0LYW <sup>(1)</sup> | -40 to 85°C                 | 6 Lead SC70  | 7" Tape and Reel, 3,000pcs |

Note: (1). 'YW' is date coding scheme. 'Y' stands for calendar year, and 'W' stands for single workweek coding scheme.

## Pin configuration (Top View)



| Pin | Pin Name         | Function               |
|-----|------------------|------------------------|
| 1   | V <sub>IN</sub>  | Input Voltage.         |
| 2   | GND              | Ground.                |
| 3   | SAG              | Feedback Connection.   |
| 4   | V <sub>OUT</sub> | Output Voltage.        |
| 5   | SHDN             | Shut-down.             |
| 6   | +V <sub>S</sub>  | Positive Power Supply. |
|     |                  |                        |

## Absolute Maximum Ratings<sup>Note</sup>

| Parameters                           |                                                       | Value                                | Unit |
|--------------------------------------|-------------------------------------------------------|--------------------------------------|------|
| Power Supply, V <sub>DD</sub> to GND |                                                       | 6.0                                  | V    |
| PD                                   | Power Dissipation, T <sub>A</sub> = 25°C, 6-Lead SC70 | 300                                  | mW   |
| V <sub>IN</sub>                      | Input Voltage                                         | V <sub>DD</sub> + 0.3V to GND - 0.3V |      |
| I <sub>OUT</sub>                     | Output Current                                        | 65                                   | mA   |
| T <sub>J</sub>                       | Maximum Junction Temperature                          | 150                                  | °C   |
| T <sub>A</sub>                       | Operating Temperature Range                           | -45 to 85                            | °C   |
| T <sub>STG</sub>                     | Storage Temperature Range                             | -65 to 150                           | °C   |
| TL                                   | Lead Temperature (Soldering, 10 sec)                  | 300                                  | °C   |
| θ <sub>JA</sub>                      | 6-Lead SC70                                           | 430                                  | °C/W |

(1) This data was taken with the JEDEC low effective thermal conductivity test board.

(2) This data was taken with the JEDEC standard multilayer test boards.

**\* Note:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

## ESD, Electrostatic Discharge Protection

| Symbol | Parameter                | Condition                  | Minimum Level | Unit |
|--------|--------------------------|----------------------------|---------------|------|
| HBM    | Human Body Model ESD     | MIL-STD-883H Method 3015.8 | 8             | kV   |
| CDM    | Charged Device Model ESD | JEDEC-EIA/JESD22-C101E     | 2             | kV   |

**TPF110/TPF110U/TPF110L**  
**Ultra-low Power Video Filter with Shut-down & SAG Correction**

**Electrical Characteristics** All test condition is  $V_{DD} = 3.3V$ ,  $T_A = +25^{\circ}C$ ,  $R_L = 150\Omega$  to GND, unless otherwise noted.

| SYMBOL                                 | PARAMETER                                  | CONDITIONS                                                      | MIN  | TYP  | MAX   | UNITS      |
|----------------------------------------|--------------------------------------------|-----------------------------------------------------------------|------|------|-------|------------|
| <b>Input Electrical Specifications</b> |                                            |                                                                 |      |      |       |            |
| $V_{DD}$                               | Supply Voltage Range                       |                                                                 | 2.85 |      | 5.5   | V          |
| $I_{DD(ON)}$                           | Quiescent Current ( $I_Q$ ) <sup>(1)</sup> | TPF110: $V_{DD}=3.3V$ , $V_{IN}=500mV$ , $EN=V_{DD}$ , no load  |      | 3.9  | 4.9   | mA         |
|                                        |                                            | TPF110: $V_{DD}=5.0V$ , $V_{IN}=500mV$ , $EN=V_{DD}$ , no load  |      | 5.1  | 6.3   | mA         |
|                                        |                                            | TPF110L: $V_{DD}=3.3V$ , $V_{IN}=500mV$ , $EN=V_{DD}$ , no load |      | 1.9  | 2.8   | mA         |
|                                        |                                            | TPF110L: $V_{DD}=5.0V$ , $V_{IN}=500mV$ , $EN=V_{DD}$ , no load |      | 2.9  | 3.9   | mA         |
| $I_{DD(OFF)}$                          | Disabled Current                           | $V_{DD}=3.3V$ , $EN=0$                                          |      | 0.5  | 1.5   | $\mu A$    |
|                                        |                                            | $V_{DD}=5.0V$ , $EN=0$                                          |      | 1.5  | 3     | $\mu A$    |
| $V_{OLS}$                              | Output Level Shift Voltage                 | $V_{IN} = 0V$ , no load, input referred                         | 53   | 80   | 124   | mV         |
| $V_{CLAMP}$                            | Input Voltage Clamp                        | $I_{IN} = -100\mu A$                                            | -40  | 0    | +40   | mV         |
| $I_{CLAMP-CHG}$                        | Clamp Charge Current                       | $V_{IN} = V_{CLAMP} - 200mV$                                    | -1.5 | -1.7 |       | mA         |
| $I_{CLAMP-DCHG}$                       | Clamp Discharge Current                    | $V_{IN} = 500mV$                                                | 1.5  | 2.0  | 5.1   | $\mu A$    |
| $R_{IN}$                               | Input Impedance                            | $0.5V < V_{IN} < 1.0V$                                          | 0.5  | 3    |       | M $\Omega$ |
| $AV$                                   | Voltage Gain                               | $V_{IN}=0.5V, 1V$ and $2V$<br>$R_L = 150\Omega$ to GND          | 5.9  | 6.01 | 6.025 | dB         |
| $A_{SAG}$                              | SAG Correction DC Gain to $V_{OUT}$        | SAG open                                                        |      | 2.25 |       | V/V        |
| PSRR                                   | Power Supply Rejection Ratio               | $\Delta V_{DD} = 3.3V$ to $3.6V$                                |      | 61   |       | dB         |
|                                        |                                            | $\Delta V_{DD} = 5.0V$ to $5.5V$ , $50Hz$ , $V_{IN}=0.7V$       |      | 67   |       | dB         |
| $V_{OH}$                               | Output Voltage High Swing                  | $V_{IN} = 3V$ , $R_L = 150\Omega$ to GND                        |      | 3.18 |       | V          |
| $V_{OL}$                               | Output Voltage Low Swing                   | $V_{IN} = -0.3V$ , $R_L = 75\Omega$                             |      | 0.05 |       | V          |
| $I_{SC}$                               | Short-circuit current                      | $V_{IN}=2V$ , output to GND through $10\Omega$                  | 65   |      |       | mA         |
|                                        |                                            | $V_{IN}=100mV$ , output short to $V_{DD}$                       | 65   |      |       | mA         |
| $V_{IL}$                               | Disable Threshold                          | $V_{DD} = 3.0V$ to $5.5V$                                       |      |      | 0.8   | V          |
| $V_{IH}$                               | Enable Threshold                           | $V_{DD} = 3.0V$ to $5.5V$                                       | 1.6  |      |       | V          |
| $R_{OUT}$                              | Output Impedance                           | $EN = 0V$ DC                                                    |      | 12   |       | k $\Omega$ |
|                                        |                                            | $EN = 0V$ , $f = 4.5MHz$                                        |      | 5.8  |       | k $\Omega$ |

Note: (1). 100% tested at  $T_A=25^{\circ}C$ .

**TPF110/TPF110U/TPF110L**
**Ultra-low Power Video Filter with Shut-down & SAG Correction**

| SYMBOL                              | PARAMETER                               | CONDITIONS                                               | MIN  | TYP  | MAX  | UNITS      |
|-------------------------------------|-----------------------------------------|----------------------------------------------------------|------|------|------|------------|
| <b>AC Electrical Specifications</b> |                                         |                                                          |      |      |      |            |
| $f_{-1dB}$                          | -1dB Bandwidth <sup>(2)</sup>           | $R_L=150\Omega$                                          | 7.6  | 8.2  | 9.1  | MHz        |
| $f_{-3dB}$                          | -3dB Bandwidth <sup>(2)</sup>           | $R_L=150\Omega$                                          | 7.8  | 9    | 10.5 | MHz        |
| $Att_{27MHz}$                       | Stop Band Attenuation <sup>(2)</sup>    | $f = 27MHz$                                              | 38.2 | 57.2 | 73.6 | dB         |
| SR                                  | Slew Rate                               | 2V output step, 80% to 20%                               |      | 38   |      | V/ $\mu$ s |
| dG                                  | Differential Gain                       | Video input range 1V                                     |      | 0.4  | 1.2  | %          |
| dP                                  | Differential Phase                      | Video input range 1V                                     |      | 0.7  | 1.5  | °          |
| THD                                 | Total Harmonic Distortion               | TPF110: $f=1MHz$ , $V_{OUT}=1.4V_{PP}$                   | 0.03 | 0.1  | 0.2  | %          |
|                                     |                                         | TPF110L: $f=1MHz$ , $V_{OUT}=1.4V_{PP}$                  |      | 0.2  |      | %          |
| D/DT                                | Group Delay Variation                   | $f = 100kHz$ , 5MHz                                      |      | 5.4  |      | ns         |
| $t_{PD}$                            | Propagation Delay                       | Maximum delay from input to output:<br>100kHz to 4.43MHz | 54   | 80.7 | 127  | ns         |
|                                     | Input-to-Output Isolation<br>(Disabled) | $f = 1MHz$ , $V_{IN}=0.7V_{PP}$                          | -89  | -96  |      | dB         |
| SNR                                 | Signal-to-Noise Ration                  | $f= 100kHz$ to 4.43MHz                                   | 65   | 68   |      | dB         |
| $t_{ON}$                            | Enable Time                             | $V_{IN} = 500mV$ , $V_{OUT}$ to 1%                       |      | 1000 |      | ns         |
| $t_{OFF}$                           | Disable Time                            | $V_{IN} = 500mV$ , $V_{OUT}$ to 1%                       |      | 45   |      | ns         |
| CLG                                 | Chroma-Luma-Gain <sup>(2)</sup>         | 400kHz to 3.58MHz and 4.43MHz                            |      | 0.18 | 0.8  | dB         |
| CLD                                 | Chroma-Luma-Delay                       | 400kHz to 3.58MHz and 4.43MHz                            |      | 9.2  | 31   | ns         |
| $t_F$                               | Falling Time                            | $2.5V_{STEP}$ , 80% - 20%                                |      | 25   |      | ns         |
| $t_R$                               | Rising Time                             | $2.5V_{STEP}$ , 20% - 80%                                |      | 22   |      | ns         |

Note: (2). Guaranteed by design.

**Typical Performance Characteristics** All test condition is  $V_{DD} = 3.3V$ ,  $T_A = +25^{\circ}C$ ,  $R_L = 150\Omega$  to GND, unless otherwise noted.

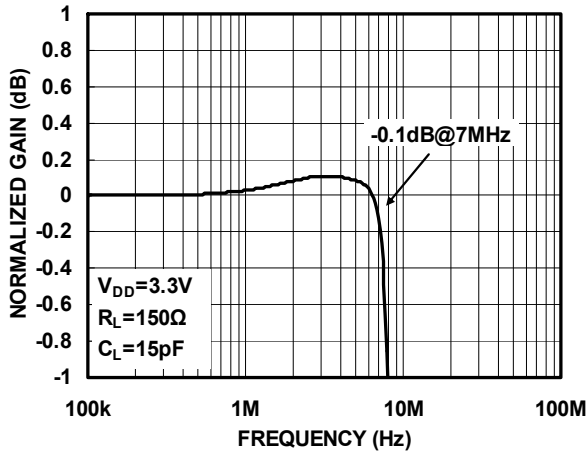


Figure1. Small-Scale Frequency Response

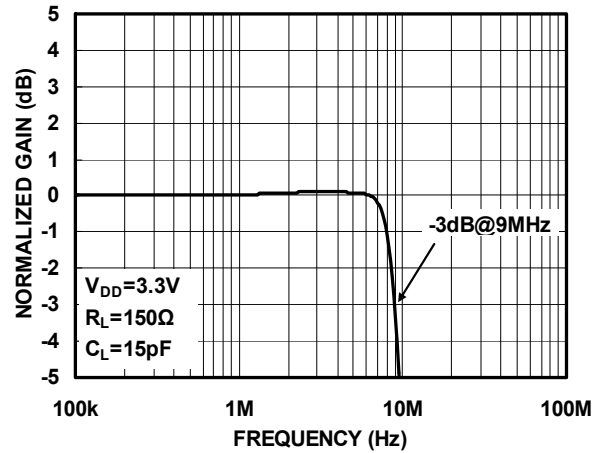


Figure2. Large-Scale Frequency Response

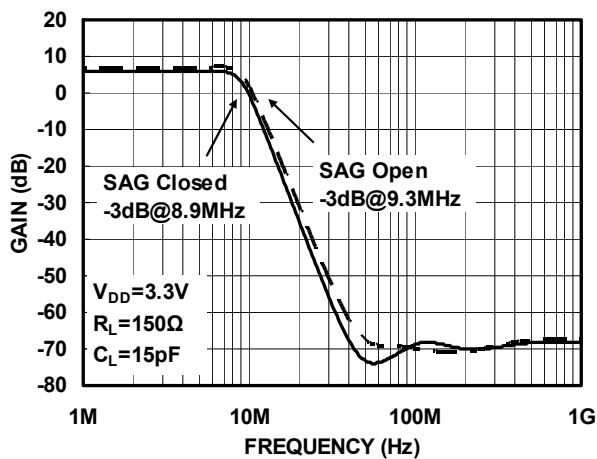


Figure3. Gain Vs. Frequency

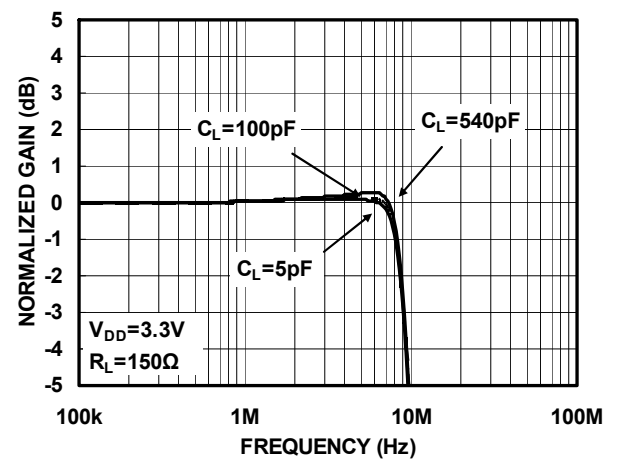


Figure4. Gain Vs. Frequency With  $C_{LOAD}$

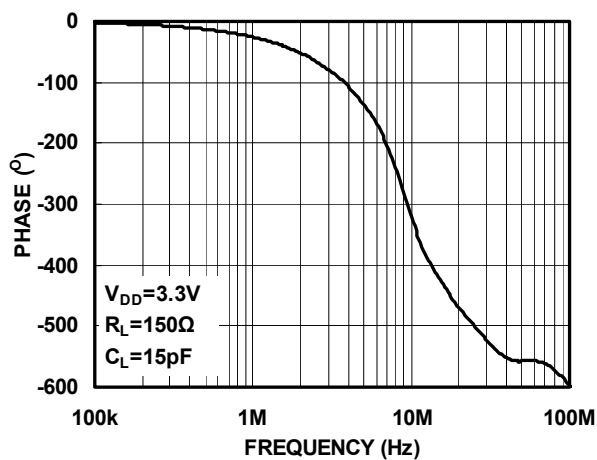


Figure5. Phase Vs. Frequency

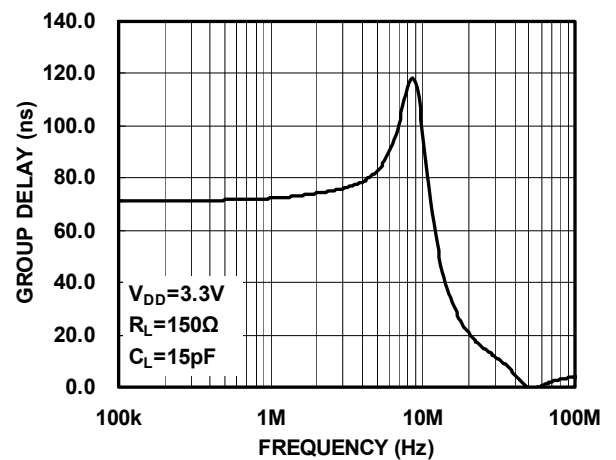


Figure6. Group Delay vs Frequency

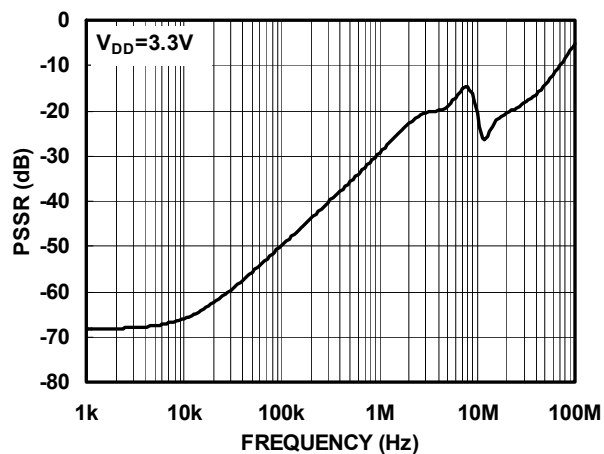


Figure7. PSRR Vs. Frequency

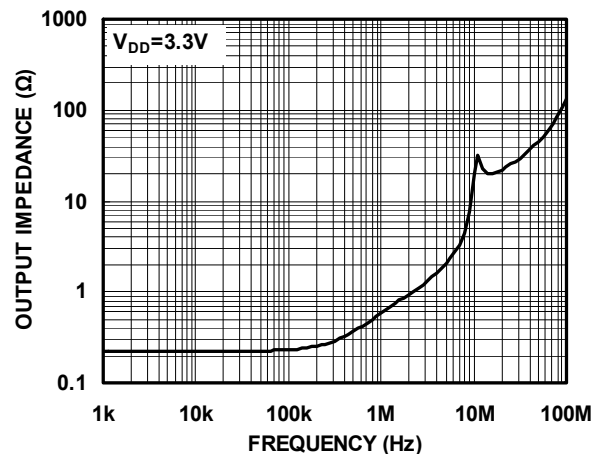


Figure8. Output Impedance Vs. Frequency

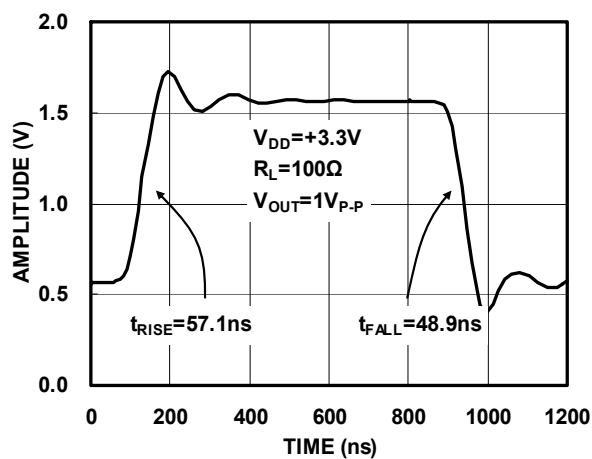


Figure9. Large-Signal Pulse Response Vs. Time

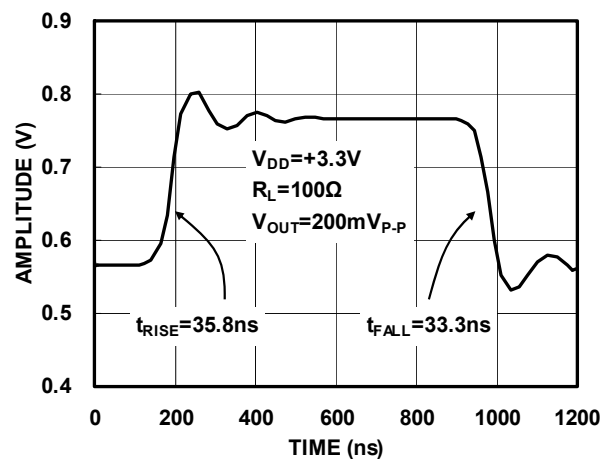


Figure10. Large-Signal Pulse Response Vs. Time

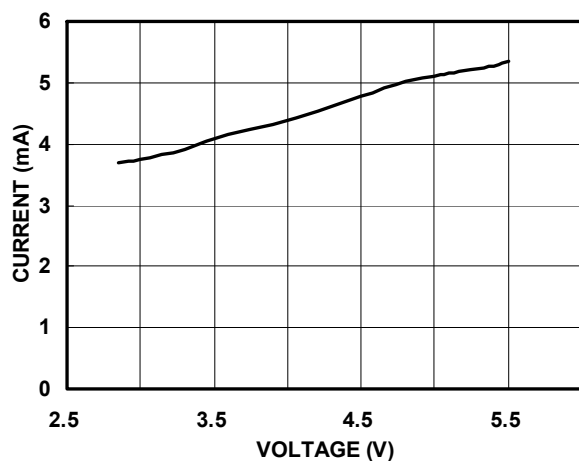


Figure11. Quiescent Current Vs. Power Supply Voltage

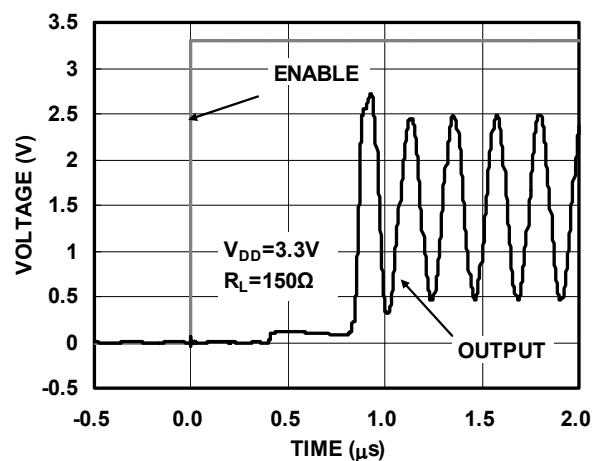


Figure12. Enable Response Time

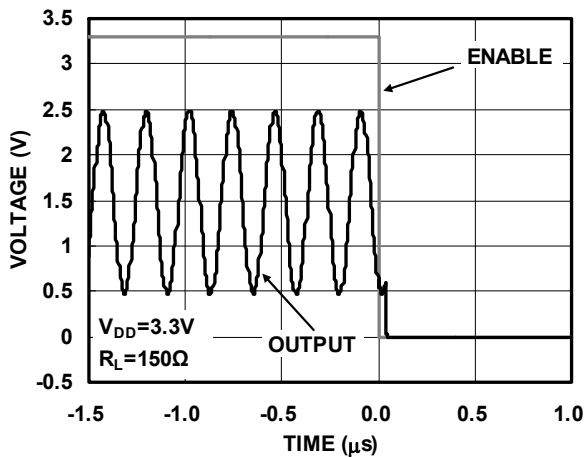


Figure13. Disable Response Time

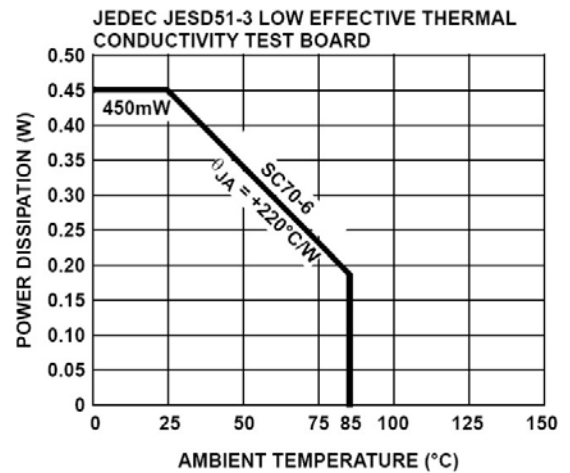


Figure14. Package Power Dissipation Vs. Ambient Temperature

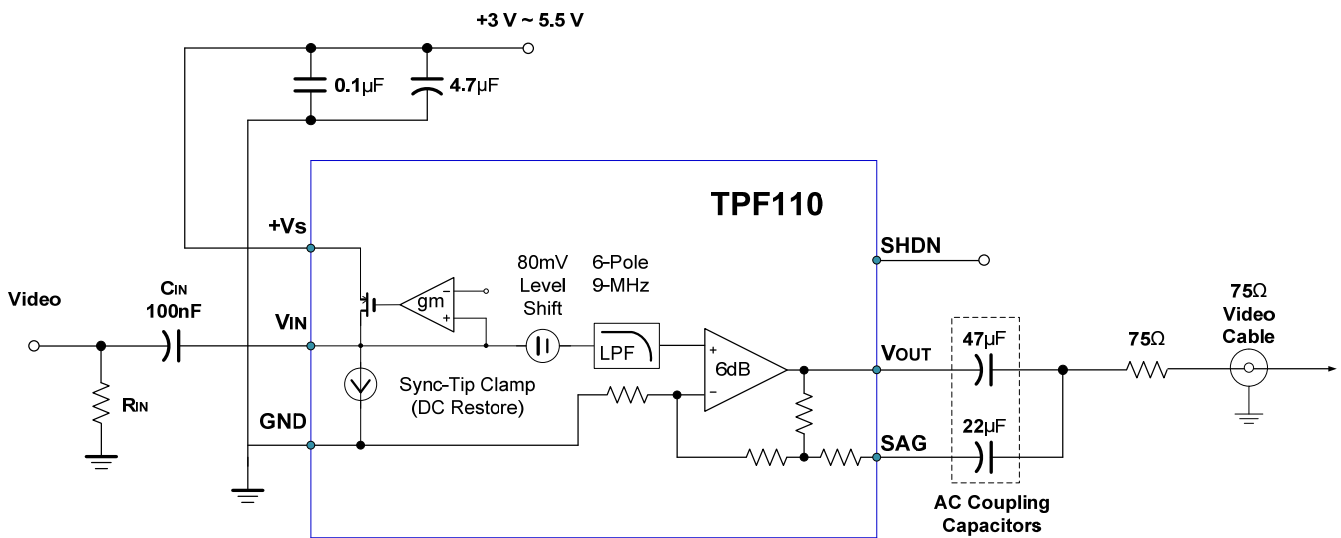


Figure15. Typical Application

## Application Information

The TPF110/TPF110L is a single supply rail-to-rail output amplifier achieving a -3dB bandwidth of around 9MHz and slew rate of about 38V/μs while demanding only 3.85mA of supply current. This part is ideally suited for applications with specific micro power consumption and high bandwidth demands. As the performance characteristics above and the features described below, the TPF110/TPF110L is designed to be very attractive for portable composite video applications.

The TPF110/TPF110L features a sync clamp, low pass function, and SAG network at the output facilitating

reduction of typically large AC coupling capacitors. See Figure 15.

## Internal Sync Clamp

The typical embedded video DAC operates from a ground referenced single supply. This becomes an issue because the lower level of the sync pulse output may be at a 0V reference level to some positive level. The problem is presenting a 0V input to most single supply driven amplifiers will saturate the output stage of the amplifier resulting in a clipped sync tip and degrading the video image. A larger positive reference

may offset the input above its positive range.

The TPF110/TPF110L features an internal sync clamp and offset function to level shift the entire video signal to the best level before it reaches the input of the amplifier stage. These features are also helpful to avoid saturation of the output stage of the amplifier by setting the signal closer to the best voltage range.

The simplified block diagram of the TPF110/TPF110L in Page-1. The AC coupled video sync signal is pulled negative by a current source at the input of the comparator amplifier. When the sync tip goes below the comparator threshold the output comparator is driven negative, The PMOS device turns on clamping sync tip to near ground level. The network triggers on the sync tip of video signal.

## Low Pass Filter--Sallen Key

The Sallen Key is a classic low pass configuration. This provides a very stable low pass function, and in the case of the TPF110/TPF110L, a six-pole roll-off at around 9MHz. The six-pole function is accomplished with an RC low pass network placed in series with and before the Sallen Key.

## Output Couple

TPF110/TPF110L output could support both "AC Couple" and "DC Couple", if use "AC Couple", this capacitor is typically between 220-μF and 1000-μF, although 470-μF is common. This value of this capacitor must be this large to minimize the line tilt (droop) and/or field tilt associated with ac-coupling as described previously in this document.

The TPF110/TPF110L internal sync clamp makes it possible to DC couple the output to a video load, eliminating the need for any AC coupling capacitors, thereby saving board space and additional expense for capacitors. This makes the TPF110/TPF110L extremely attractive for portable video applications. Additionally, this solution completely eliminates the issue of field tilt in the lower frequency. The trade off is greater demand of supply current. Typical load current for AC coupled is around 1mA, compared to typical 6.6mA used when DC coupling.

## Output Drive Capability and Power Dissipation

With the high output drive capability of the TPF110/TPF110L, it is possible to exceed the +125°C absolute maximum junction temperature under certain load current conditions. Therefore, it is important to calculate the maximum junction temperature for an application to determine if load conditions or package types need to be modified to assure operation of the amplifier in a safe operating area. The maximum power dissipation allowed in a package is determined according to Equation:

$$PD_{MAX} = \frac{T_{JMAX} - T_{AMAX}}{\theta_{JA}}$$

Where:

$T_{JMAX}$  = Maximum junction temperature

$T_{AMAX}$  = Maximum ambient temperature

$\theta_{JA}$  = Thermal resistance of the package

The maximum power dissipation actually produced by an IC is the total quiescent supply current times the total power supply voltage, plus the power in the IC due to the load, or: for sourcing:

$$PD_{MAX} = V_S \times I_{SMAX} + (V_S - V_{OUT}) \times \frac{V_{OUT}}{R_L}$$

Where:

$V_S$  = Supply voltage

$I_{SMAX}$  = Maximum quiescent supply current

$V_{OUT}$  = Maximum output voltage of the application

$R_{LOAD}$  = Load resistance tied to ground

By setting the two PD<sub>MAX</sub> equations equal to each other, we can solve the output current and R<sub>LOAD</sub> to avoid the device overheat.

## Power Supply Bypassing Printed Circuit Board Layout

As with any modern operational amplifier, a good printed circuit board layout is necessary for optimum performance. Lead lengths should be as short as possible. The power supply pin must be well bypassed to reduce the risk of oscillation. For normal single supply operation, a single 4.7μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor from VS+ to GND will suffice.

**TPF110/TPF110U/TPF110L**  
**Ultra-low Power Video Filter with Shut-down & SAG Correction**

**VIDEO FILTER DRIVER SELECTION GUIDE**

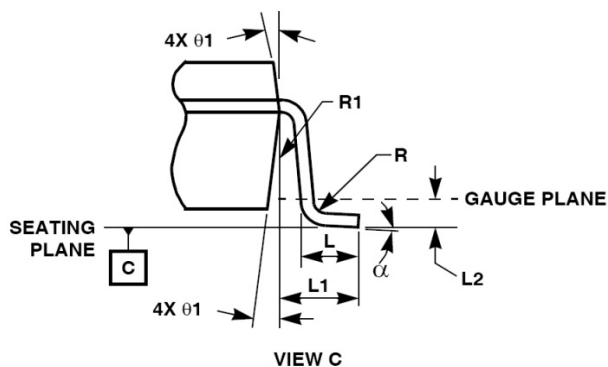
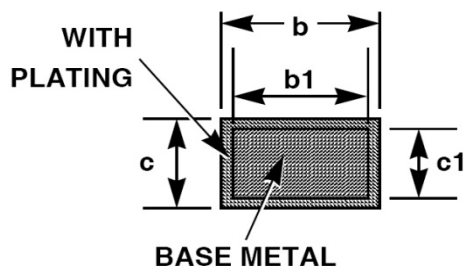
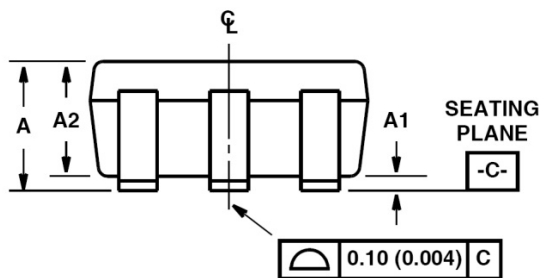
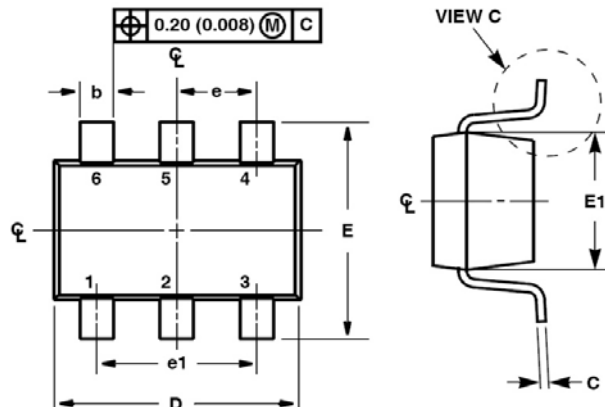
| P/N    | Product Description                                                                              | Channel        | -3dB Bandwidth | Package             |
|--------|--------------------------------------------------------------------------------------------------|----------------|----------------|---------------------|
| TPF111 | Low power, 1 channel 6 <sup>th</sup> order<br>9MHz                                               | 1-SD           | 9MHz           | SC70-5<br>SO-8      |
| TPF113 | Low power 3 channel, 6th-order<br>9MHz SD video filter                                           | 3-SD           | 9MHz           | SO-8                |
| TPF114 | Low power 4 channel, 6th-order<br>9MHz SD video filter                                           | 4-SD           | 9MHz           | MSOP-10<br>TSSOP-14 |
| TPF116 | Low power 4 channel, 6th-order<br>9MHz SD video filter for CVBS,<br>SVIDEO                       | 6-SD           | 9MHz           | TSSOP-14            |
| TPF123 | 3 channel 6th-order 13.5MHz,<br>960H/720H-CVBS video filter or<br>Y'Pb'Pr 480P/576P video filter | 3-ED           | 13.5MHz        | SO-8                |
| TPF133 | Low power 3 channel, 6th-order<br>36MHz HD video filter                                          | 3-HD           | 36MHz          | SO-8                |
| TPF134 | Low power 3 channel, 6th-order<br>36MHz HD video filter and 1 channel<br>SD video filter         | 1-SD&<br>3-SD  | 9MHz<br>36MHz  | MSOP-10<br>TSSOP-14 |
| TPF136 | Low power 3 channel, 6th-order<br>36MHz HD video filter and 3 channel<br>SD video filter         | 3-SD&<br>3-HD  | 9MHz<br>36MHz  | TSSOP-20            |
| TPF143 | Low power 3 channel, 6th-order<br>72MHz Full HD video filter                                     | 3-FHD          | 72MHz          | SO-8                |
| TPF144 | Low power 3 channel, 6th-order<br>72MHz Full HD video filter and 1<br>channel SD video filter    | 1-SD&<br>3-FHD | 9MHz<br>72MHz  | MSOP-10<br>TSSOP-14 |
| TPF146 | Low power 3 channel, 6th-order<br>72MHz Full HD video filter and 3<br>channel SD video filter    | 3-SD&<br>3-FHD | 9MHz<br>72MHz  | TSSOP-20            |
| TPF153 | Low power 3 channel, 6th-order<br>220MHz Full HD video filter                                    | 3-CH           | 220MHz         | SO-8                |



TPF110/TPF110U/TPF110L  
Ultra-low Power Video Filter with Shut-down & SAG Correction

## 封装信息

### Small Outline Transistor Plastic Packages (SC70-6)



### 6 LEAD OUTLINE TRANSISTOR PLASTIC PACKAGE

| SYMBOL   | INCHES    |       | MILLIMETERS |      | NOTES |
|----------|-----------|-------|-------------|------|-------|
|          | MIN       | MAX   | MIN         | MAX  |       |
| A        | 0.031     | 0.039 | 0.80        | 1.00 | -     |
| A1       | 0.001     | 0.004 | 0.025       | 0.10 | -     |
| A2       | 0.034     | 0.036 | 0.85        | 0.90 | -     |
| b        | 0.006     | 0.012 | 0.15        | 0.30 | -     |
| b1       | 0.006     | 0.010 | 0.15        | 0.25 | -     |
| c        | 0.004     | 0.008 | 0.10        | 0.20 | 6     |
| c1       | 0.004     | 0.006 | 0.10        | 0.15 | 6     |
| D        | 0.073     | 0.085 | 1.85        | 2.15 | 3     |
| E        | 0.084BSC  |       | 2.1 BSC     |      | -     |
| E1       | 0.045     | 0.053 | 1.15        | 1.35 | 3     |
| e        | 0.0256Ref |       | 0.65 Ref    |      | -     |
| e1       | 0.0512Ref |       | 1.30 Ref    |      | -     |
| L        | 0.010     | 0.018 | 0.26        | 0.46 | 4     |
| L1       | 0.016 Ref |       | 0.40 Ref    |      | -     |
| L2       | 0.006 BSC |       | 0.15 BSC    |      | -     |
| N        | 6         |       | 6           |      | 5     |
| R        | 0.04      | -     | 0.10        | -    | -     |
| $\alpha$ | 0°        | 8°    | 0°          | 8°   | -     |

#### NOTES:

1. Dimensioning and tolerance per ASME Y14.5M-1994.
2. Package conforms to EIAJ SC70 and JEDEC MO203AB.
3. Dimensions D and E1 are exclusive of mold flash, protrusions, or gate burrs.
4. Footlength L measured at reference to gauge plane.
5. "N" is the number of terminal positions.
6. These Dimensions apply to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
7. Controlling dimension: MILLIMETER. Converted inch dimensions are for reference only

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**Contact information:**

USA: 635 W. Alma School Road, Suite102

Chandler, USA.

AZ 85234

Shanghai-China: Room 401-407 No.1278 Keyuan Road,

Zhangjiang High-tech Park, Pudong New District,

Shanghai, China

Zip Code: 201203

Suzhou-China: Suite 304, Building B2, Creative Industrial Park,

No.328 Xinghu Street, Industrial Park,

Suzhou, Jiangsu Province, China

Zip Code: 215123