


SANYO Semiconductors

DATA SHEET

LA72910V — Monolithic Linear IC FM Modulator and Demodulator IC

Overview

The LA72910V is a FM modulation and demodulation single-chip IC. Its adjustment free modulation/demodulation circuit significantly reduces the number of peripheral circuits required and can contribute to lower production costs.

Functions

- Video signal FM modulation and demodulation
- Video signal emphasis and de-emphasis function
- Drop-Out detecting function of Video FM signal
- FM mute function at Second-Call

Specifications

Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|---------------------|-------------|-------------|------|
| Maximum supply voltage | V _{CC} max | | 7.0 | V |
| Allowable power dissipation | Pd max | | 300 | mW |
| Operating temperature | T _{opr} | Ta ≤ 70°C * | -30 to +70 | °C |
| Storage temperature | T _{stg} | | -40 to +150 | °C |

When mounted on a 114.3mm × 76.1mm × 1.6mm, glass epoxy.

Recommended Operating Conditions at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------------|--------------------|-------------------|------------|------|
| Recommended supply voltage | V _{CC} | | 5.0 | V |
| Allowable operating voltage range | V _{CC} op | Ta = -30 to +70°C | 4.7 to 5.5 | V |

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LA72910V

Electrical Characteristics at Ta = 25°C, VCC = 5V

DC CHARACTERISTICS T6 = 0.4V, T9 = 2.0V, T10 = 0.4V

| Parameter | Symbol | In | OUT | Conditions | Ratings | | | Unit |
|--|----------------|----------|-----|---|---------|------|------|-------|
| | | | | | min | typ | max | |
| Control terminal (Pin6,9) Low level | CNT6L CNT9L | T6 T9 | | Low level of control terminal of ALL mode. T6 = 0.4V(DEMOD mode), T9 = 0.4V (Standby mode) | 0 | | 0.4 | V |
| Control terminal (Pin6,9)High level | CNT6H CNT9H | T6 T9 | | High level of input terminal of ALL mode T6 = 2.0V (MOD mode), T9 = 2.0V (Normal mode) | 2.0 | | 5.0 | V |
| Input5 Low level | IN5L | T5 | | Low level of input terminal of MOD mode T6 = 2.0V, T9 = 2.0V, T10 = 0.4V | 0 | | 0.4 | V |
| Input5 High level | IN5H | T5 | | High level of input terminal of MOD mode T6 = 2.0V, T9 = 2.0V, T10 = 0.4V | 2.0 | | 5.0 | V |
| Input10 Low level | IN10L | T10 | | Low level of input terminal of MOD mode T5 = 0.4V, T6 = 2.0V, T9 = 2.0V | 0 | | 0.4 | V |
| Input10 High level | IN10H | T10 | | High level of input terminal of MOD mode T5 = 0.4V, T6 = 2.0V, T9 = 2.0V | 2.0 | | 5.0 | V |
| Output10 terminal High level | OPH10 | | T10 | DEMOM mode: FM-Signal input T6 = 0.4V, T9 = 2.0V, Pull-UP:15KΩ | 4.7 | | | V |
| Output10 terminal Low level | OPL13 OPL18 | | T10 | T10: DEMOM mode: FM No-signal Measure the sink level of output terminal. T6 = 0.4V, T9 = 2.0V, Pull-UP:15KΩ | 0 | 0.25 | 0.4 | V |
| Input12 Low level | IN12L | T12 | T12 | Voltage of terminal at AGC ON T6 = 0.4V, T9 = 2.0V | 0 | | 3 | V |
| Input12 High level | IN12H | T12 | T12 | Voltage of terminal at AGC OFF T6 = 0.4V, T9 = 2.0V | 4.5 | | 5.0 | V |
| 5pin AC input dynamic range | ACIN5 | T5A | T3 | Input amplitude level of FM signal Freq: 11.5MHz to 13.5MHz | | | 1000 | mVp-p |
| 16pin AC input dynamic range | ACIN16 | T16A | T3 | Maximum input level of T16A at Video signal | | | 1.5 | Vp-p |

Video FM Modulation Block (MOD) T6=2.0V,T9=2.0V,T10=0.4V,T15=5V

| Parameter | Symbol | In | OUT | Conditions | Ratings | | | Unit |
|---|--------|------|-----|---|---------|------|------|-------|
| | | | | | min | typ | max | |
| Current dissipation | ICC R | | | measure the currents into pins 2 (MOD mode) | 19.5 | 23.0 | 26.5 | mA |
| FM modulator output level | VFM1 | | T3 | Measure the output level on T3 (No signal input) It is load impedance 200Ω between T3-GND. | | 1.8 | 2.2 | Vp-p |
| FM Mute output level | VFM2 | | T3 | Measure the T3 output level with 2nd call | 0 | 10 | 20 | mVp-p |
| Carrier frequency | FFM | | T3 | Measure the output frequency on T3 with no signal input | 10.9 | 11.5 | 12.1 | MHz |
| FM output Second harmonic distortion | THD2 | | T3 | Measure the second harmonics distortion with the above condition | | -30 | -20 | dB |
| Deviation | DEV | T16A | T3 | With T16A 100% White 1Vp-p signal, Measure the deviation on T3 | 1.9 | 2.0 | 2.1 | MHz |
| FM modulator linearity (11.5MHz to 13.5MHz) | LMOD | T16A | T3 | Let f2.85, f3.35 and f3.85 be the output frequency when 2.85V, 3.35V and 3.85V is applied to T16A $LMOD = \frac{f3.35 - (f3.85 + f2.85) / 2}{f3.85 - f2.85} \times 100$ | -2 | 0 | +2 | % |
| Emphasis gain | GEMP | T16A | T12 | With VIN a 300mVp-p 10kHz sine wave, Measure the ratio of the levels on T16A and T12 | -7.5 | -6.0 | -4.5 | dB |
| Main linear emphasis characteristics(1) | GME1 | T16A | T12 | With VIN a 300mVp-p 500kHz sine wave, Measure the ratio of the levels on T16A and T12 | -1.5 | 0.0 | +1.5 | dB |
| Main linear emphasis characteristics(2) | GME2 | T16A | T12 | With VIN a 300mVp-p 2MHz sine wave, Measure the ratio of the levels on T16A and T12 | 2.5 | 4.0 | 5.5 | dB |
| White clipping level | LWC | T16A | T12 | With VIN a 1.5Vp-p 100% white video signal. Measure the white clipping level on T12 | 180 | 200 | 220 | % |
| Dark clipping level | LDC | T16A | T12 | With VIN a 1.5Vp-p 100% white video signal. Measure the dark clipping level on T12. | -60 | -50 | -40 | % |
| FM stop beginning delay time (VD characteristic 1B) | TC1 | T5 | T3 | C7=0.01μF, Time from fall of T5 signal to doing of FM carrier of T3 STOP | 240 | 300 | 360 | μsec |
| FM stop time (VD characteristic2A) | TC2 | T5 | T3 | C8=0.001μF, Stop time of FM carrier of T3 | 30 | 40 | 50 | μsec |
| Minimum VD pulse width | VDT | T5 | T3 | C7=0.01μF, Minimum VD pulse width to which TC1B is normally output | 63 | | | μsec |

LA72910V

Video FM De-modulation Block (DEM0D) T6=0.4V,T9=2.0V

| Parameter | Symbol | In | OUT | Conditions | Ratings | | | Unit |
|--|----------------------------|------------|------------|---|---------|------|------|-----------------|
| | | | | | min | typ | max | |
| Current dissipation | I _{CCP} | | | Measure the currents into pin 2 (DEM0D mode) | 24.0 | 28.0 | 32.0 | mA |
| Video output level | VOUT | T5A | T3 | Demodulation level, when the FM signal of 2.2MHz deviation. Load impedance = 1kΩ T3-GND. | 2.09 | 2.2 | 2.31 | V _{pp} |
| Video output level B | VOUTB | T5A | T3 | Demodulation level, when the FM signal of 2.0MHz deviation. Load impedance = 1kΩ T3-GND. In this case only, V _{CC} make 4.5V to 5.5V. | 1.9 | 2.0 | 2.1 | V _{pp} |
| FM stop detection level (DOC characteristic 1) | DOC1 | T5A T12 | T10 T12 | T5 = 11.5MHz, 300mVp-p. Measure T12 voltage (V12). Set T12 V12 (AGC-Fix). T5 input level when T5 amplitude is decrease gradually, and T10 becomes "Low" | | 40 | 60 | mVp-p |
| (Drop Delay Down) | DDD | T5A T12 | T10 T12 | Shift time from T5=300mVp-p→0mVp-p to T10"Low". | 0.5 | 1.5 | 2.5 | μsec |
| FM return judgment level | DOC2 | T5A T12 | T10 T12 | T5=11.5MHz, 300mVpp, Measure T12 Voltage (V12). Set T12 V12 (AGC-Fix). T5 inputs the level when T5 amplitude is increase gradually, and T10 becomes "High" | | 60 | 90 | mVp-p |
| Video DC level when returning | DOC2B | T5A T12 | T15 | Confirmation of output of Video signal from T3. Measurement of DC level. | 0.5 | 1.0 | 1.5 | V |
| (Drop Delay Rise) Return operation delay time | DWR | T5A T12 | T10 T12 | Shift time from T5 = 0mVp-p→300mVp-p to T10"High" | 0.2 | 1.5 | 2.5 | μsec |
| 4V Regulator | VREG | | T4 | Measurement of T4 DC level. | 3.9 | 4.0 | 4.3 | V |
| Range of input Dynamic range | ACIN5 | T5A | T3 | DEV = 2.0MHz. Input amplitude level of FM signal. (T5A: 11.5MHz to 13.5MHz) | | 500 | 1000 | mVp-p |
| DG | DG | T5A | T3 | | 0 | 6 | 10 | % |
| DP | DP | T5A | T3 | | 0 | 6 | 10 | deg |
| Output voltage at mute | MUV | | T3 | Mute level measurement of T3 | 0 | 10 | 20 | IRE |
| FM demodulation voltage (11.0M) | VDEM11 VDEM12 VDEM13 | T5A | T15 | T5A = 11MHz, 100mVp-p, 200mVp-p and 400mVp-p. Each T15 voltage measurement | 0.3 | 0.8 | 1.3 | V |
| FM demodulation voltage (12.5M) | VDEM21 VDEM22 VDEM23 | T5A | T15 | T5A = 12.5MHz, 100mVp-p, 200mVp-p and 400mVp-p. Each T15 voltage measurement | 0.7 | 1.2 | 1.7 | V |
| FM demodulation voltage (14.0M) | VDEM31 VDEM32 VDEM33 | T5A | T15 | T5A = 14MHz, 100mVp-p, 200mVp-p and 400mVp-p Each T15 voltage measurement | 1.1 | 1.6 | 2.1 | V |
| FM demodulation linearity1.2.3 | LDEM1 LDEM2 LDEM3 | | | Calculate FM demodulation linearity LDEM1 = {[VDEM21 - (VDEM11 + VDEM31) / 2] / (VDEM31 - VDEM11)}×100 LDEM2 = {[VDEM22 - (VDEM12 + VDEM32) / 2] / (VDEM32 - VDEM12)}×100 LDEM3 = {[VDEM23 - (VDEM13 + VDEM33) / 2] / (VDEM33 - VDEM13)}×100 | -2 | 0 | +2 | % |
| FM demodulation Sensitivity1.2.3 | SDEM1 SDEM2 SDEM3 | | | Calculate FM recovery Sensitivity with consider pin3 output level conversion ratio. SDEM1 = (VDEM31-VDEM11)/2.5 SDEM2 = (VDEM32-VDEM12)/2.5 SDEM3 = (VDEM33-VDEM13)/2.5 | 0.28 | 0.33 | 0.38 | V/MHz |
| Main linear de-emphasis amplitude | GMED | T5A | T15 | T5=200mVp-p FM signal (fm = 10kHz, Center Carrier = 12.5MHz, DEV = 1.0MHz) Signal level of T15 | 243 | 270 | 297 | mVp-p |
| Main linear de-emphasis Characteristics(1) | GMED1 | T5A | T15 | T5 = 200mVp-p FM signal (fm = 500kHz, Center Carrier = 12.5MHz, DEV = 1.5MHz). Signal level of T15 versus GMRD (Ratio of GMED). | -8.0 | -6.0 | -4.0 | dB |
| Main linear de-emphasis Characteristics(2) | GMED2 | T5A | T15 | T5 = 200mVp-p FM signal (fm = 2MHz, Center Carrier = 9.25MHz, DEV = 1.5MHz). Signal level of T15 versus GMRD (Ratio of GMED) | -11.0 | -9.0 | -7.0 | dB |

LA72910V

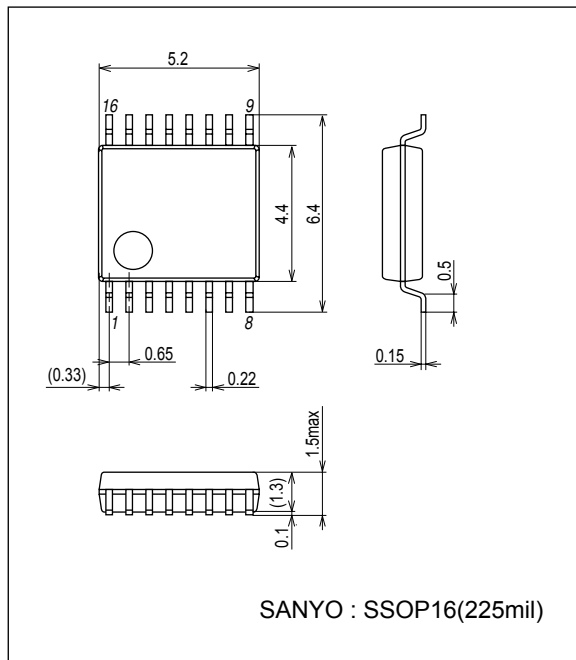
Standby (Standby mode) T9=0.4V

| Parameter | Symbol | In | OUT | Conditions | Ratings | | | Unit |
|--|------------------|-----------------|-----|--|---------|-----|------|------|
| | | | | | min | typ | max | |
| Current dissipation at standby | I _{CCS} | T9 | | Measure the currents into pin 2. (Standby mode) | 5.0 | 8.0 | 11.0 | mA |
| Standby release time(1) (FM stop→release) | SASK1 | T6 T9 | T3 | T6 = 2.0VDC T9 = 0V→2V (Standby release) Time until FM career is output to T3. | 0.0 | 1.0 | 2.0 | usec |
| Standby release time(2) (Video signal stop →release) | SASK2 | T6 T5A T9 | T3 | T6 = 0.4V, T5 = DEV = 1.5MHz 100% white video signal of FM signal. T9 = 0V→2V (Standby release), Time until white 100% signal is output to T3 | 2.0 | 7.0 | 12.0 | usec |

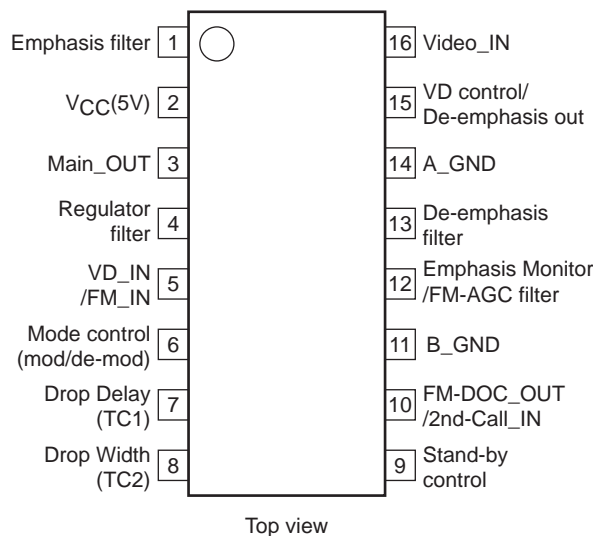
Package Dimensions

unit : mm (typ)

3178B

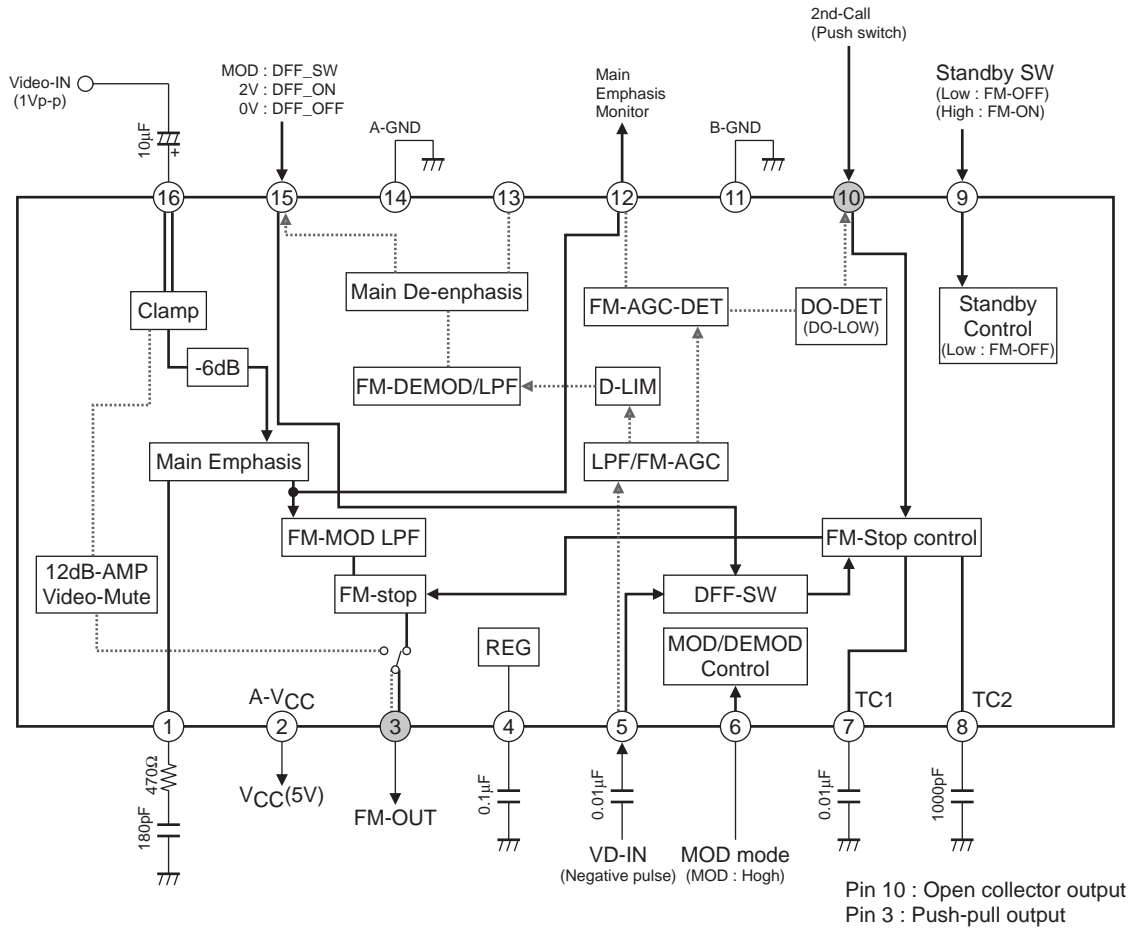


Pin Assignment

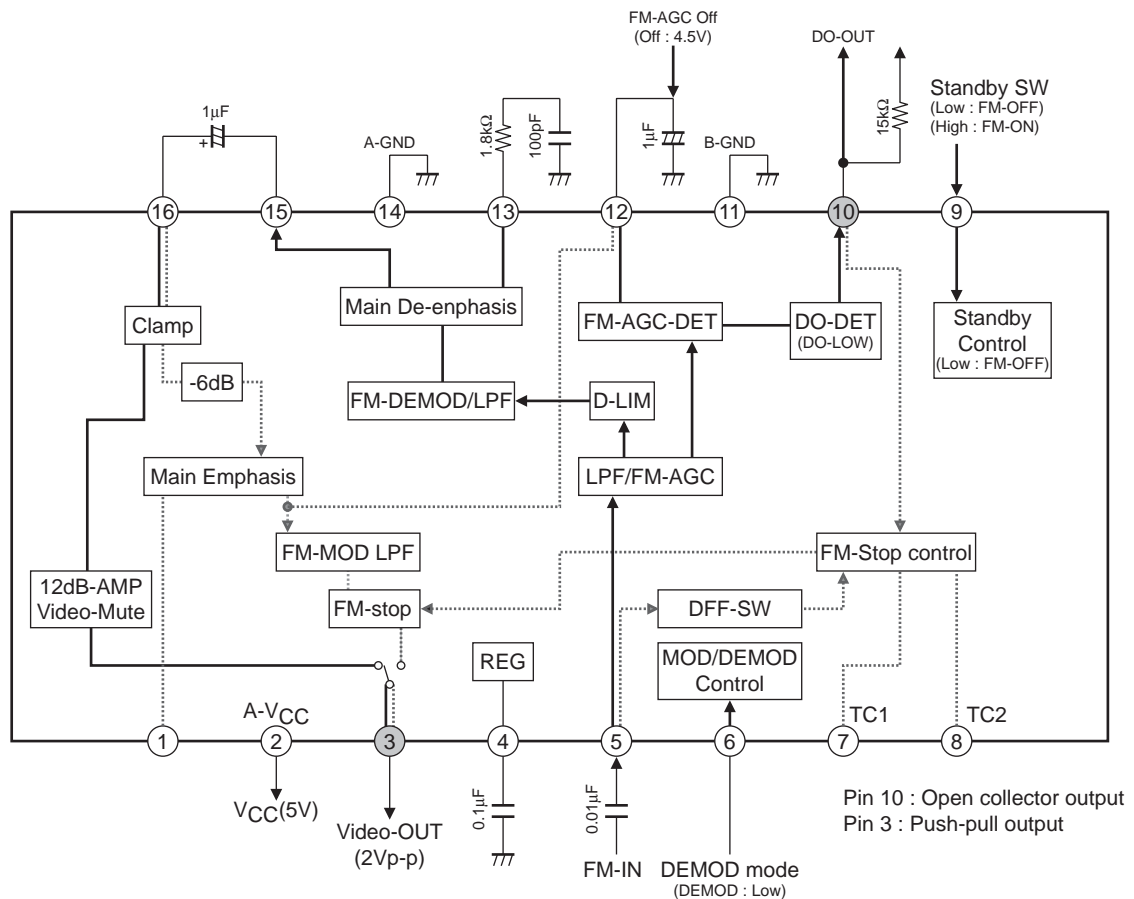


LA72910V

Block Diagram and Application Circuit Example1 Modulation (Camera)



Application Circuit Example2 Demodulation (Monitor)



LA72910V

Pin Function

| Pin No. | Pin name | FM MOD mode(Outside camera) | FM DEMOD mode(Inside Monitor) | Note |
|---------|------------------------------------|--|---|--|
| 1 | Emphasis filter | Emphasis filter connection pin | Non connect(Hi-Z) | If you don't need, this pin is open. |
| 2 | V _{CC} 5V | V _{CC} for FM modulation. | V _{CC} for FM demodulation. | |
| 3 | Main_OUT | FM Output (Ro=200Ω:1.8Vp-p) | Video Output (Ro=1kΩ:2Vp-p) | Push-pull output |
| 4 | Regulator filter | FM modulation block reference DC power supply. | FM demodulation block reference DC power supply. | |
| 5 | VD_IN/FM_IN | VD Input (Hi: over 2V, Low: under 0.4V) (VD DET: High) | FM Input (Recommend Level: 100 to 620mVp-p) | DEMODO mode:Set 3.3V by internal bias. (34kΩ/66kΩ) |
| 6 | Mode control | Set over 2V DC voltage. | Set under 0.4V DC voltage. | Outside camera / Inside monitor setting. |
| 7 | Drop delay (TC1) | Connect TC1 setting C. | Non connect(Hi-Z) | |
| 8 | Drop Width (TC2) | Connect TC2 setting C. | Non connect(Hi-Z) | |
| 9 | Stand-by control | FM blocks standby control. (FM block operate: over 2V , FM block standby: under 0.4V) | ← | |
| 10 | FM-DOC-OUT /2nd-Call control | 2nd-Call input, 2nd-Call: Low (High: over 2V, Low: under 0.4V) | DOC output (When DO-DET, output is Low) | DEMODO mode: Open collector output. |
| 11 | B-GND | Circuit GND | ← | |
| 12 | Emphasis Monitor /FM-AGC filter | Emphasis monitor output | FM AGC control filter (AGC-ON: 0 to 3V DC, AGC-OFF: 4.5V to 5V by external DC voltage.) | MOD mode: Don't connect capacitor. |
| 13 | De-emphasis filter | Non connect(Hi-Z) | De-emphasis filter connection pin. | If you don't need, this pin is open. |
| 14 | A-GND | Circuit GND | ← | |
| 15 | VD control /De-emphasis out | DFF control (ON: over 2V, OFF: under 0.4V) | DE-emphasis output | |
| 16 | Video_IN | Video signal input (from outside CCD camera: 1Vp-p). | Video signal input (from de-emphasis block: 0.5Vp-p). | MOD mode: Maximum video input level is 1.5Vp-p. |

LA72910V

Pin Description

| Pin No. | Pin Name | Description | Equivalent circuit |
|---------|--------------------|--|--------------------|
| 1 | Emphasis filter | Main Emphasis filter pin. Before FM Modulation, make emphasis characteristic at video signal. Emphasis time constant must be matching at de-emphasis time constant. (If you don't need the emphasis, this pin is open.) | |
| 2 | V _{CC} 5V | V _{CC} pin. Supply voltage is 5V DC. Please connect de-coupling capacitor. | |
| 3 | Main_OUT | Push-Pull output pin. MOD mode: FM carrier output. (1.8Vp-p: Rout=200Ω) DEMOD mode: Video signal output. (2.0Vp-p: Rout=1kΩ) | |
| 4 | Regulator filter | Internal regulator filter pin. Please connect 0.1μF (C1) | |
| 5 | VD_IN/FM_IN | DEMOD mode: FM signal input. Internal DC bias is 3.3V. Please use capacitor (C1) coupling. MOD mode: VD signal input. Please input VD signal directly. Please consider input impedance. | |
| 6 | Mode control | MOD mode/ DEMOD mode setting pin. MOD mode: Please set over 2V DC voltage. (2 to 5V). DEMOD mode: Please set under 0.4V DC voltage. (0 to 0.4V). | |

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LA72910V

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| Pin No. | Pin Name | Description | Equivalent circuit |
|---------|---------------------------------|--|--------------------|
| 7 | Drop delay (TC1) | MOD mode: TC1 filter pin. Please connect C1. | |
| 8 | Drop Width (TC2) | MOD mode: TC2 filter pin. Please connect C1. | |
| 9 | Stand-by control | Standby control pin. FM block standby: under 0.4V DC voltage. (0 to 0.4V) FM block operate: over 2V DC voltage. (2 to 5V) | |
| 10 | FM-DOC-OUT /2nd-Call control | DEMODO mode: Drop-out output pin. This pin is open collector output, so please connect pull up resistor. MOD mode: 2nd-CALL input. 2nd-CALL input: under 0.4V (0 to 0.4V) DC. Normal: over 2V DC voltage. (2 to 5V) | |
| 11 | B-GND | Circuit GND. | |
| 12 | Emphasis Monitor /FM-AGC filter | MOD mode: Emphasis monitor pin. DEMODO mode: FM AGC filter pin. If FM AGC no need (=AGC Off), Please set pin12 voltage over 4.5V DC voltage. (4.5 to 5V) | |

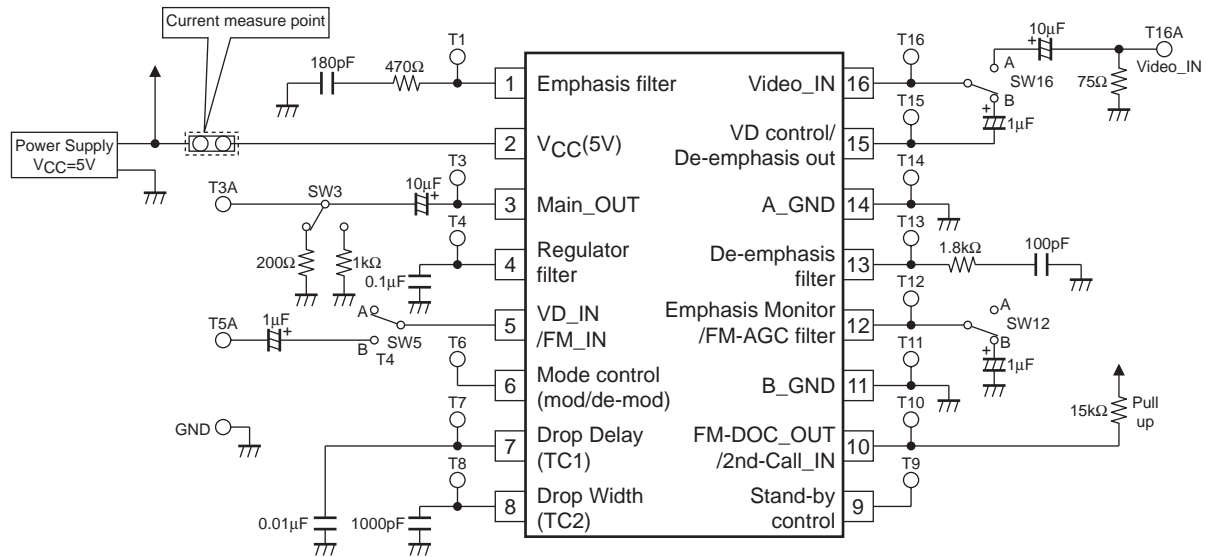
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LA72910V

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| Pin No. | Pin Name | Description | Equivalent circuit |
|---------|-----------------------------|---|--------------------|
| 13 | De-emphasis filter | DEMOM mode: De-emphasis filter pin. De-emphasis time constant must be matching at emphasis time constant. (If you don't need the emphasis, this pin is open.) | |
| 14 | A-GND | Circuit GND. | |
| 15 | VD control /De-emphasis out | DEMOM mode: Video signal output after De-emphasis. Output level is 0.5Vp-p. Connect capacitor to clamp input (pin 16). MOD mode: DFF control pin. DFF is ON at over 2V DC voltage. (2 to 5V) | |
| 16 | Video_IN | MOD mode: Video signal input pin (from camera). Input level is 1Vp-p. DEMOM mode: Video signal input pin (from de-emphasis). Input level is 0.5Vp-p. | |

Test Circuit



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