

US Audio Multiplexing Decoder

Description

The CXA2064M is an IC designed as a decoder for the Zenith TV Multi-channel System. Functions include stereo demodulation, SAP (Separate Audio Program) demodulation, dbx noise reduction.

Features

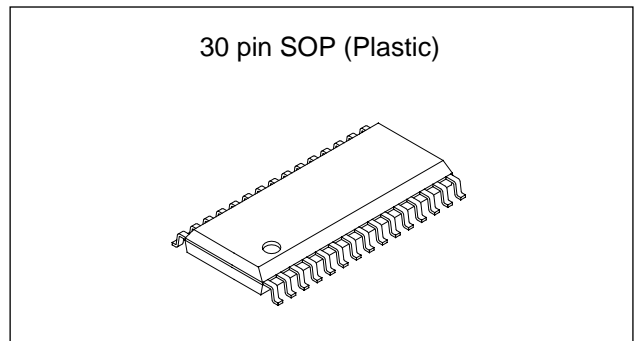
- Adjustment free of VCO and filter.
- Audio multiplexing decoder and dbx noise reduction decoder are all included in a single chip. Almost any sort of signal processing is possible through this IC.
- Various built-in filter circuits greatly reduce external parts.
- This IC is near pin to pin compatible with the CXA2020M.

Applications

TV, VCR and other decoding systems for US audio multiplexing TV broadcasting

Structure

Bipolar silicon monolithic IC



Absolute Maximum Ratings (Ta = 25°C)

| | | | |
|-------------------------------|------------------|-------------|----|
| • Supply voltage | V _{CC} | 11 | V |
| • Operating temperature | T _{opr} | -20 to +75 | °C |
| • Storage temperature | T _{stg} | -65 to +150 | °C |
| • Allowable power dissipation | P _D | 1000 | mW |
| • STID, SAPID drive current | I _o | 2 (max.) | mA |

Range of Operating Supply Voltage

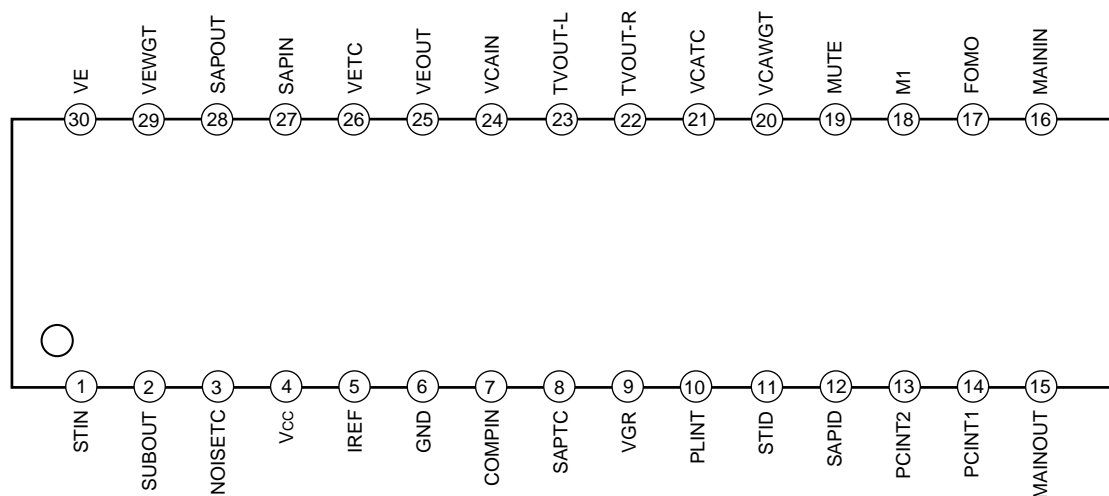
9 ± 0.5 V

* This device is available only to the licensees of the dbx-TV noise reduction system.

Standard I/O Level

- Input level
COMPIN (Pin 7) 100mVrms (MONO 100Hz 100% mod.)
- Output level
TVOUT-L/R (Pins 23 and 22) 490mVrms (MONO 100Hz 100% mod.)

Pin Configuration (Top View)



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| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|--------|-------------|--------------------|---|
| 5 | IREF | 1.3V | | <p>Set the filter and VCO reference current. (Connect a 68kΩ (±1%) resistor between this pin and GND.)</p> |
| 6 | GND | — | | <p>Analog block GND.</p> |
| 7 | COMPIN | 4.0V | | <p>Audio multiplexing signal input pin.</p> |
| 8 | SAPTC | 4.5V | | <p>Set the time constant for the SAP carrier detection circuit. (Connect a 4.7µF capacitor between this pin and GND.)</p> |

| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|--------|-------------|--------------------|--|
| 9 | VGR | 1.3V | | Band gap reference output pin. (Connect a 10 μ F capacitor between this pin and GND.) |
| 10 | PLINT | 5.1V | | Pilot cancel circuit loop filter integrating pin. (Connect a 1 μ F capacitor between this pin and GND.) |
| 11 | STID | — | | Stereo detection pin. Open collector output. Drive current is 2mA (Max.). |
| 12 | SAPID | — | | SAP detection pin. Open collector output. Drive current is 2mA (Max.). |

| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|---------|-------------|--------------------|--|
| 13 | PCINT2 | 4.0V | | Stereo block PLL loop filter integrating pin. |
| 14 | PCINT1 | 4.0V | | |
| 15 | MAINOUT | 4.0V | | (L + R) signal output pin. |
| 16 | MAININ | 4.0V | | Input the (L + R) signal from MAINOUT (Pin 15). |
| 17 | FOMO | — | | Mode control switch pin. This pin has 3 ranges for input voltage. Sets forced monoral mode and also control ST.ID. |
| 19 | MUTE | — | | Mode control switch pin. When this pin is set to H level, TVOUT output is muted. |

| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|---------|-------------|--------------------|---|
| 18 | M1 | — | | <p>Mode control switch pin. This pin has 3 ranges for input voltage. Stereo, BOTH, SAP selection are available.</p> |
| 20 | VCAWGT | 4.0V | | <p>Weight the VCA control effective value detection circuit. (Connect a 1µF capacitor and a 3.9kΩ resistor in series between this pin and GND.)</p> |
| 21 | VCATC | 1.7V | | <p>Determine the restoration time constant of the VCA control effective value detection circuit. (the specified restoration time constant can be obtained by connecting a 10µF capacitor between this pin and GND.)</p> |
| 22 | TVOUT-R | 4.0V | | TVOUT right channel output pin. |
| 23 | TVOUT-L | 4.0V | | TVOUT left channel output pin. |

| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|--------|-------------|--------------------|--|
| 24 | VCAIN | 4.0V | | VCA input pin. Input the variable de-emphasis output signal from Pin 25 via a coupling capacitor. |
| 25 | VEOUT | 4.0V | | Variable de-emphasis output pin. (Connect a 4.7μF non-polar capacitor between Pins 25 and 24.) |
| 26 | VETC | 1.7V | | Determine the restoration time constant of the variable de-rmphasis control effective value detection circuit. (the specified restoration time constant can be obtained by connecting a 3.3μF capacitor between this pin and GND.) |
| 28 | SAPOUT | 4.0V | | SAP FM detector output pin. |

| Pin No. | Symbol | Pin voltage | Equivalent circuit | Description |
|---------|--------|-------------|--------------------|---|
| 29 | VEWGT | 4.0V | | <p>Weight the variable de-emphasis control effective value detection circuit. (Connect a 0.047µF capacitor and a 3kΩ resistor in series between this pin and GND.)</p> |
| 30 | VE | 4.0V | | <p>Variable de-emphasis integrating pin. (Connect a 2700pF capacitor and a 3.3kΩ resistor in series between this pin and GND.)</p> |

Electrical Characteristics

COMPIN input level
(100% modulation level)

Main (L + R) (Pre-Emphasis: OFF) = 100mVrms

SUB (L - R) (dbx-TV: OFF) = 200mVrms

Pilot= 20mVrms

SAP Carrier= 60mVrms

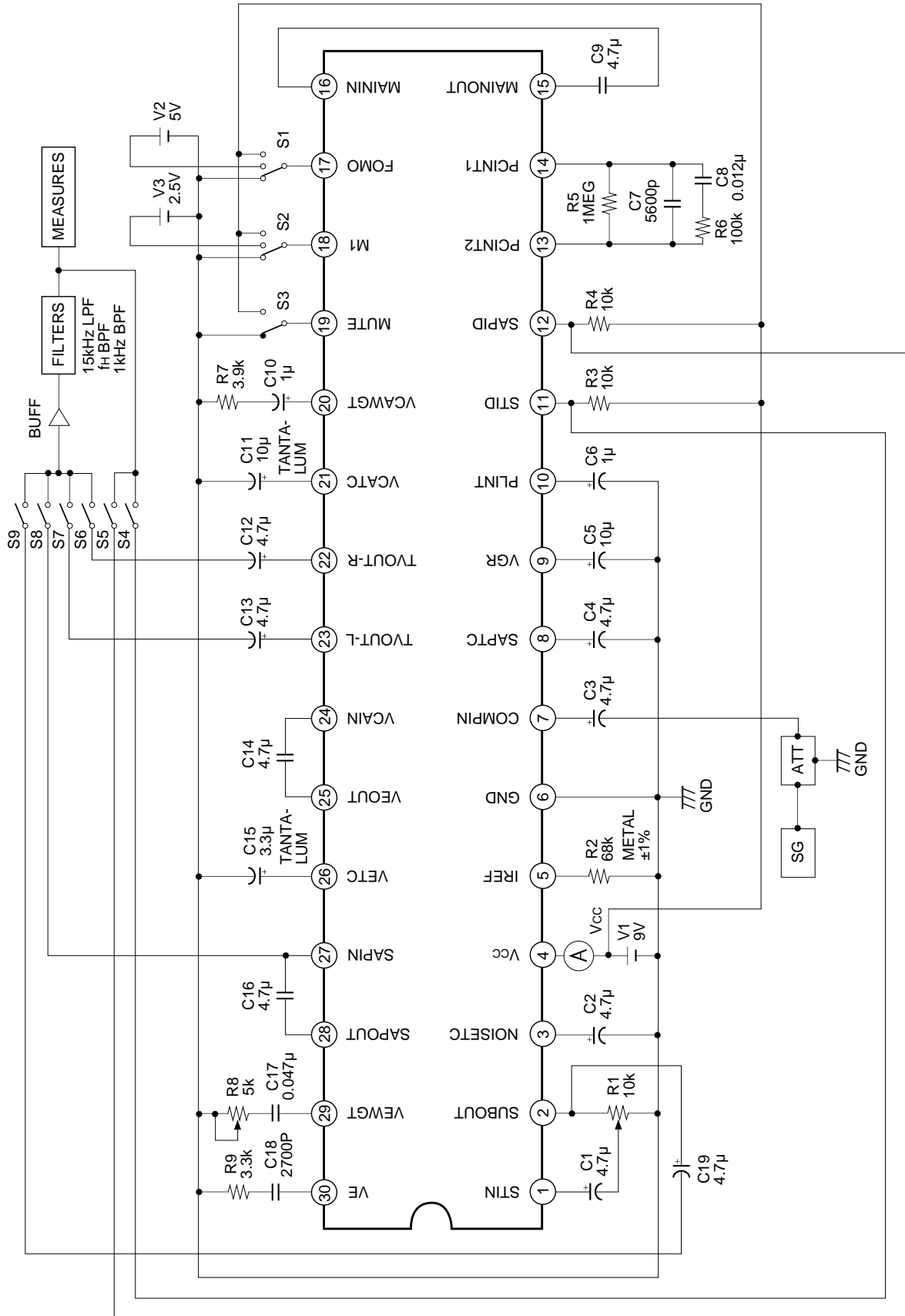
f_H = 15.734kHz

(T_a = 25°C, V_{CC} = 9V)

| No. | Item | Signal | Mode | Input pin | Input signal | Measurement conditions | Filter | Output pin | Min. | Typ. | Max. | Unit |
|-----|---|---------------------|------|-----------|---|-----------------------------------|---------------------|------------|------|------|------|-------|
| 1 | Current consumption | I _{CC} | | — | No signal | | | | 15 | 23 | 31 | mA |
| 2 | Main output level | V _{main} | MONO | 7 | Mono 1kHz 100% mod. Pre-em. ON | | | 22/23 | 440 | 490 | 540 | mVrms |
| 3 | Main de-emphasis frequency characteristic | FC _{deem} | MONO | 7 | Mono 5kHz 30% mod. Pre-em. ON | 20 log (‘5k’/‘1k’) | | 22/23 | -1.2 | 0 | 1.0 | dB |
| 4 | Main LPF frequency characteristic | FC _{main} | MONO | 7 | Mono 12kHz 30% mod. Pre-em. ON | 20 log (‘12k’/‘1k’) | | 22/23 | -3.0 | -1.0 | 1.0 | dB |
| 5 | Main distortion | THD _m | MONO | 7 | Mono 1kHz 100% mod. Pre-em. ON | | 15kLPF | 22/23 | — | 0.1 | 0.5 | % |
| 6 | Main overload distortion | THD _{mmax} | MONO | 7 | Mono 1kHz 200% mod. Pre-em. ON | | 15kLPF | 22/23 | — | 0.15 | 0.5 | % |
| 7 | Main S/N | SN _{main} | MONO | 7 | Mono 1kHz, Pre-em. ON | 20 log (‘100%’/‘0%’) | 15kLPF | 22/23 | 61 | 69 | — | dB |
| 8 | Sub output level | V _{sub} | ST | 7 | SUB (L-R) 1kHz, 100% mod., NR OFF | | | 2 | 225 | 275 | 325 | mVrms |
| 9 | Sub LPF frequency characteristic | FC _{sub} | ST | 7 | SUB (L-R) 12kHz, 30% mod., NR OFF | 20 log (‘12k’/‘1k’) | | 2 | -3.0 | -0.5 | 1.0 | dB |
| 10 | Sub distortion | THD _{sub} | ST | 7 | SUB (L-R) 1kHz, 100% mod., NR OFF | | 15kLPF | 2 | — | 0.1 | 1.0 | % |
| 11 | Sub overload distortion | THD _{smax} | ST | 7 | SUB (L-R) 1kHz, 200% mod., NR OFF | | 15kLPF | 2 | — | 0.2 | 2.0 | % |
| 12 | Sub S/N | SN _{sub} | ST | 7 | SUB (L-R) 1kHz, NR OFF | 20 log (‘100%’/‘0%’) | 15kLPF | 2 | 56 | 64 | — | dB |
| 13 | ST → SAP Crosstalk | CT _{st} | SAP | 7 | SUB (L-R) 1kHz, 100% mod., NR ON, SAP Carrier (5fh) | 20 log (‘M1 = L’/ ‘M1 = H’) | 1kBPFF | 23 | 60 | 70 | — | dB |
| 14 | Sub pilot leak | PC _{sub} | ST | 7 | PILOT (fh) 0dB | 0dB = 20mVrms | f _H BPFF | 2 | — | -27 | -16 | dB |

| No. | Item | Signal | Mode | Input pin | Input signal | Measurement conditions | Filter | Output pin | Min. | Typ. | Max. | Unit |
|-----|----------------------------------|---------|------|-----------|--------------------------------------|----------------------------------|--------|------------|-------|------|------|-------|
| 15 | Stereo ON level | THst | ST | 7 | Change PILOT (fh) Level | 0dB = 20mVrms | | 11 | -9.0 | -6.0 | -3.0 | dB |
| 16 | Stereo ON/OFF hysteresis | HYst | | | | 20 log ('on level'/ 'off level') | | | | | | |
| 17 | SAP output level | Vsap | SAP | 7 | SAP 1kHz 100% mod. NR OFF | | | 28 | 130 | 170 | 210 | mVrms |
| 18 | SAP LPF frequency characteristic | FCsap | SAP | 7 | SAP 10kHz 30% mod. NR OFF | 20 log ('10k'/'1k') | | 28 | -3.0 | 0 | 2.5 | dB |
| 19 | SAP distortion | THDsap | SAP | 7 | SAP 1kHz 100% mod. NR OFF | | 15kLPF | 28 | — | 2.5 | 6.0 | % |
| 20 | SAP S/N | SNsap | SAP | 7 | SAP 1kHz, NR OFF | 20 log ('100%'/ '0%') | 15kLPF | 28 | 46 | 55 | — | dB |
| 21 | SAP → ST Cross talk | CTsap | ST | 7 | SAP 1kHz 100% mod. NR ON, Pilot (fh) | 20 log ('M1 = H'/'M1 = L') | 1kBPf | 23 | 60 | 70 | — | dB |
| 22 | SAP ON level | THsap | SAP | 7 | Change SAP Carrier (5fh) Level | 0dB = 60mVrms | | 12 | -12.0 | -9.0 | -6.5 | dB |
| 23 | SAP ON/OFF hysteresis | HYsap | | | | 20 log ('on level'/ 'off level') | | | | | | |
| 24 | ST separation 1 L → R | STLsep1 | ST | 7 | ST-L 300Hz 30% mod. NR ON | 20 log ('Lch'/'Rch') | 15kLPF | 22/23 | 23 | 35 | — | dB |
| 25 | ST separation 1 R → L | STRsep1 | ST | 7 | ST-R 300Hz 30% mod. NR ON | 20 log ('Rch'/'Lch') | 15kLPF | 22/23 | 23 | 35 | — | dB |
| 26 | ST separation 2 L → R | STLsep2 | ST | 7 | ST-L 3kHz 30% mod. NR ON | 20 log ('Lch'/'Rch') | 15kLPF | 22/23 | 23 | 35 | — | dB |
| 27 | ST separation 2 R → L | STRsep2 | ST | 7 | ST-R 3kHz 30% mod. NR ON | 20 log ('Rch'/'Lch') | 15kLPF | 22/23 | 23 | 35 | — | dB |

Electrical Characteristics Measurement Circuit



Adjustment Method

1. Input level adjustment

- 1) Connect components as shown in Fig. 1.
- 2) Set the US MPX encoder output to MONO 100Hz 100% modulation.
- 3) Adjust the "ATT" so that COMPIN (Pin 7) level goes to 100mVrms ($\pm 0.5\text{dB}$).

2. Separation adjustment

- 1) Mode control pin are set to FOMO (Pin 17): L, M1 (Pin 18): L, MUTE (Pin 19): L.
- 2) Set the US MPX encoder output to Stereo Lch-only 300Hz 30% modulation, NR-ON.
Then, adjust the variable resistor of SUBOUT (Pin 2) to reduce the TVOUT-R output to the minimum.
- 3) Next, set the frequency only of the input signal to 3kHz and adjust the variable resistor of VEWGT (Pin 29) to reduce the TVOUT-R output to the minimum.
- 4) The adjustments in 2 and 3 above are performed to optimize the separation.

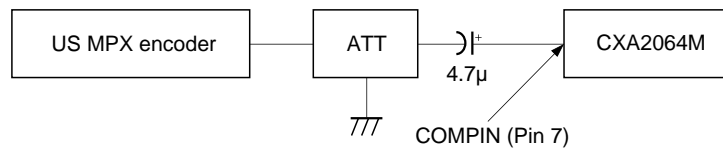


Fig. 1. Adjustment setup

* Adjust this IC through Tuner and IF when this IC is mounted on the set.

Description of Operation

The US audio multiplexing system possesses the base band spectrum shown in Fig. 2.

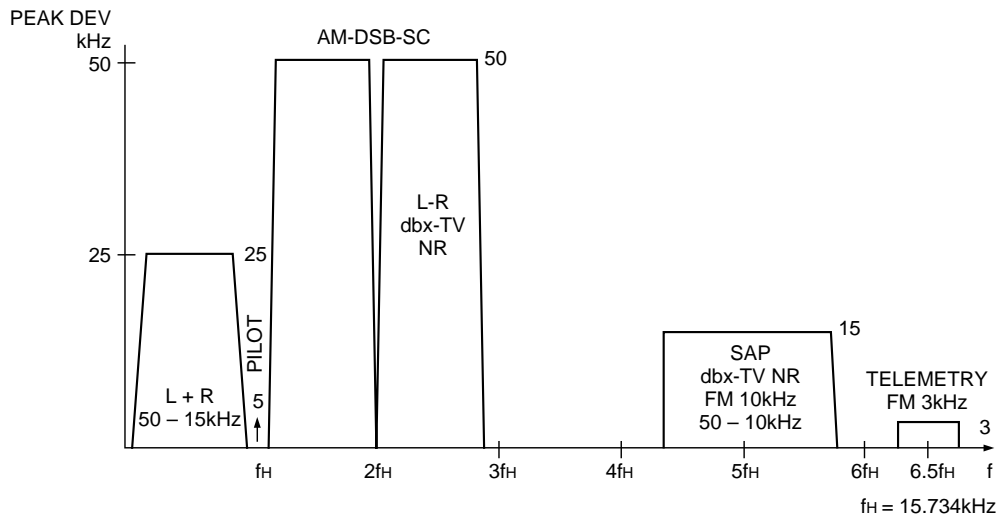


Fig. 2. Base band spectrum

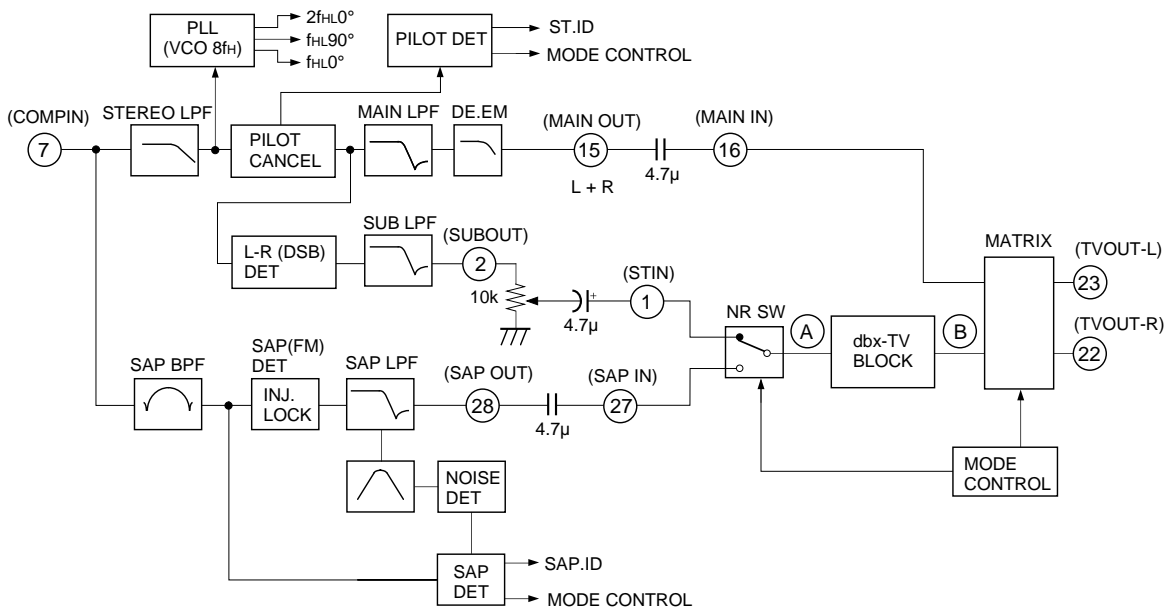


Fig. 3. Overall block diagram (See Fig. 4 for the dbx-TV block)

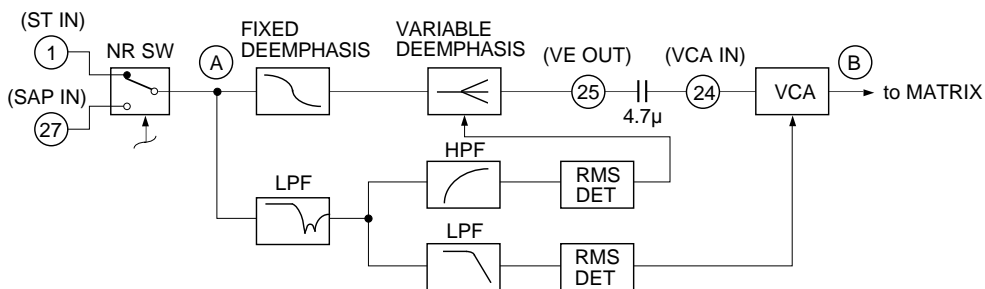


Fig 4. dbx-TV block

(1) L + R (MAIN)

When the audio multiplexing signal is inputted to COMPIN (Pin 7), the SAP signal and telemetry signal are suppressed by STEREO LPF. Next, the pilot signals are canceled. Finally, the L – R signal and SAP signal are removed by MAIN LPF, and frequency characteristics are flattened (de-emphasized) and input to the matrix.

(2) L – R (SUB)

The L – R signal follows the same course as L + R before the pilot signal is canceled. L – R has no carrier signal, as it is a suppressed-carrier double-sideband amplitude modulated signal (DSB-AM modulated). For this reason, the pilot signal is used to regenerate the carrier signal (quasi-sine wave) to be used for the demodulation of the L – R signal. In the last stage, the residual high frequency components are removed by SUB LPF and the L – R signal is input to the dbx-TV block via the NRSW circuit.

(3) SAP

SAP is an FM signal using 5fH as a carrier as shown in the Fig. 2. First, the SAP signal only is extracted using SAP BPF. Then, this is subjected to FM detection. Finally, residual high frequency components are removed and frequency characteristics flattened using SAP LPF, and the SAP signal is input to the dbx-TV block via the NRSW circuit.

(4) Mode discrimination

Stereo discrimination is performed by detecting the pilot signal amplitude. SAP discrimination is performed by detecting the 5fH carrier amplitude. NOISE discrimination is performed by detecting the noise near 25kHz after FM detection of SAP signal.

(5) dbx-TV block

Either the L – R signal or SAP signal input respectively from STIN (Pin 1) or SAPIN (Pin 27) is selected by the mode control and input to the dbx-TV block.

The input signal then passes through the fixed de-emphasis circuit and is applied to the variable de-emphasis circuit. The signal output from the variable de-emphasis circuit passes through an external capacitor and is applied to VCA (voltage control amplifier). Finally, the VCA output is converted from a current to a voltage using an operational amplifier and then input to the matrix.

The variable de-emphasis circuit transmittance and VCA gain are respectively controlled by Each of effective value detection circuits. Each of the effective value detection circuits passes the input signal through a predetermined filter for weighting before the effective value of the weighted signal is detected to provide the control signal.

(6) Matrix

The signals (L + R, L – R, SAP) input to "MATRIX" become the outputs for the ST-L, ST-R, MONO and SAP signals according to the mode control and whether there is ST / SAP discrimination.

(7) Others

"Bias" supplies the reference voltage and reference current to the other blocks. The current flowing to the resistor connecting IREF (Pin 5) with GND become the reference current.

Decoder Output and Mode Control Table

| Input signal mode | ID | | Pin | | dbx input | Output | |
|-------------------|----|-----|-----|------|-----------|--------|-------|
| | ST | SAP | M1 | FOMO | | Lch | Rch |
| MONO | H | H | L | * | MUTE | L + R | L + R |
| | H | H | M | * | MUTE | L + R | L + R |
| | H | H | H | * | MUTE | L + R | L + R |
| STEREO | L | H | L | L | L - R | L | R |
| | L | H | L | M | MUTE | L + R | L + R |
| | H | H | L | H | MUTE | L + R | L + R |
| | L | H | M | L | MUTE | L + R | L + R |
| | L | H | M | M | MUTE | L + R | L + R |
| | H | H | M | H | MUTE | L + R | L + R |
| | L | H | H | L | L - R | L | R |
| | L | H | H | M | MUTE | L + R | L + R |
| | H | H | H | H | MUTE | L + R | L + R |
| MONO & SAP | H | L | L | * | MUTE | L + R | L + R |
| | H | L | M | * | SAP | L + R | SAP |
| | H | L | H | L | SAP | SAP | SAP |
| | H | L | H | M | SAP | L + R | SAP |
| | H | L | H | H | SAP | L + R | SAP |
| STEREO & SAP | L | L | L | L | L - R | L | R |
| | L | L | L | M | MUTE | L + R | L + R |
| | H | L | L | H | MUTE | L + R | L + R |
| | L | L | M | L | SAP | L + R | SAP |
| | L | L | M | M | SAP | L + R | SAP |
| | H | L | M | H | SAP | L + R | SAP |
| | L | L | H | L | SAP | SAP | SAP |
| | L | L | H | M | SAP | L + R | SAP |
| | H | L | H | H | SAP | L + R | SAP |

*: Don't care

Regarding ST, SAP, ID

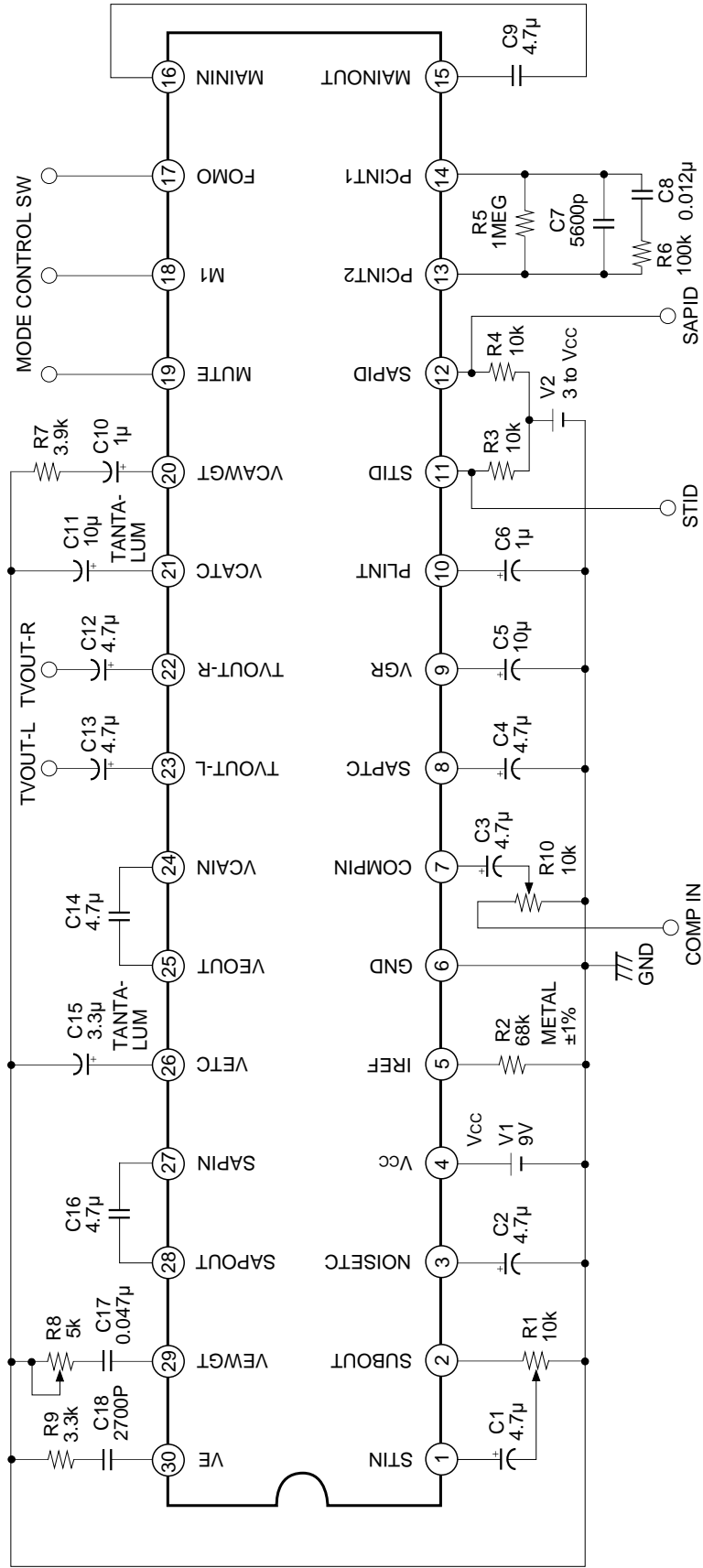
L shows that drive current runs through load register and pin voltage is low.

H shows that drive current doesn't run through load resistor and pin voltage is high.

Limits of Control Voltage

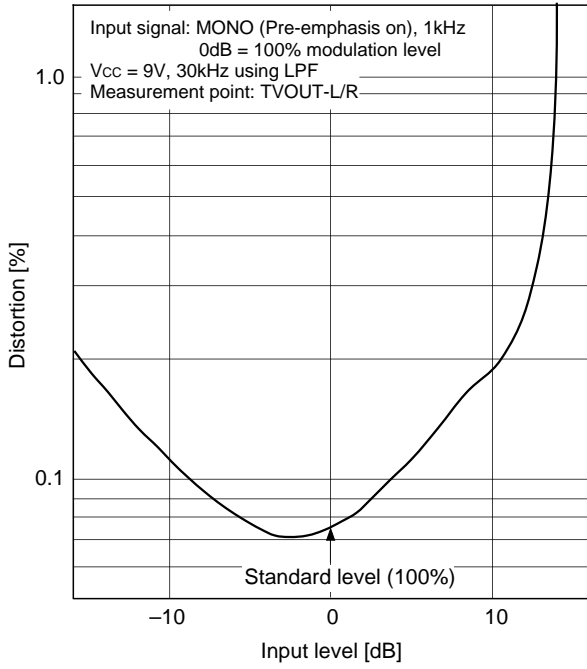
| | | | |
|------|---|--------|---------------------|
| M1 | H | SAP | 4.5V to V_{cc} |
| | M | BOTH | 2 to 3V (or OPEN) |
| | L | STEREO | 0 to 0.5V |
| FOMO | H | STID-H | 8.5V to V_{cc} |
| | M | STID-L | 3 to 7V |
| | L | STID-L | 0 to 0.5V (or OPEN) |
| MUTE | H | ON | 3V to V_{cc} |
| | L | OFF | 0 to 0.5V (or OPEN) |

Application Circuit

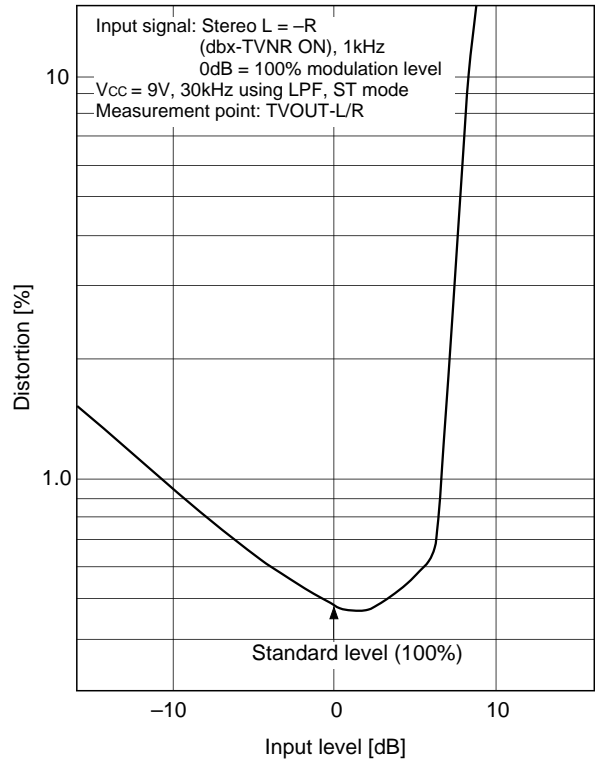


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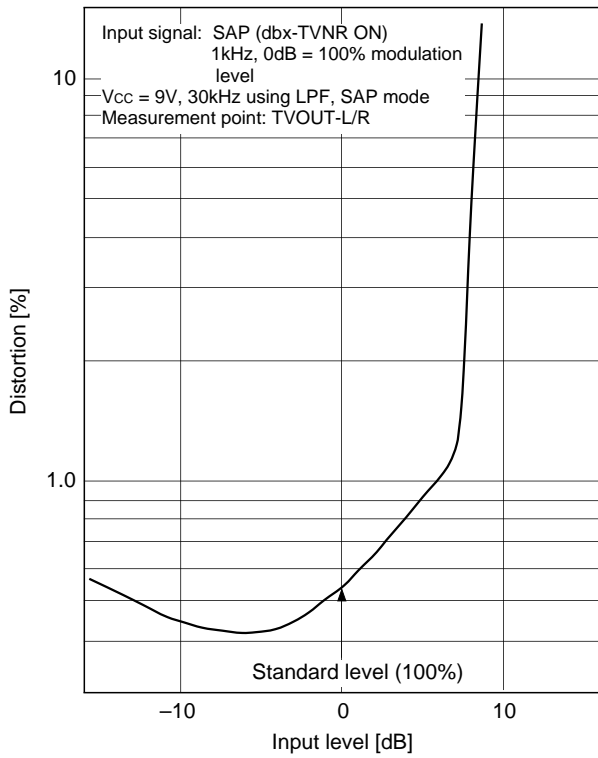
Input level vs. Distortion characteristics 1 (MONO)



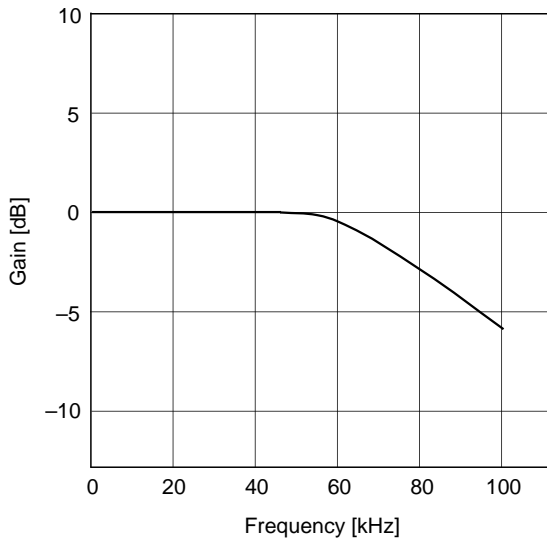
Input level vs. Distortion characteristics 2 (Stereo)



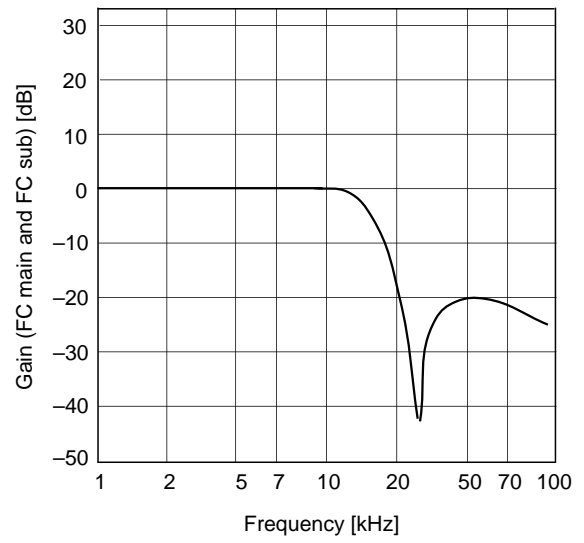
Input level vs. Distortion characteristics 3 (SAP)



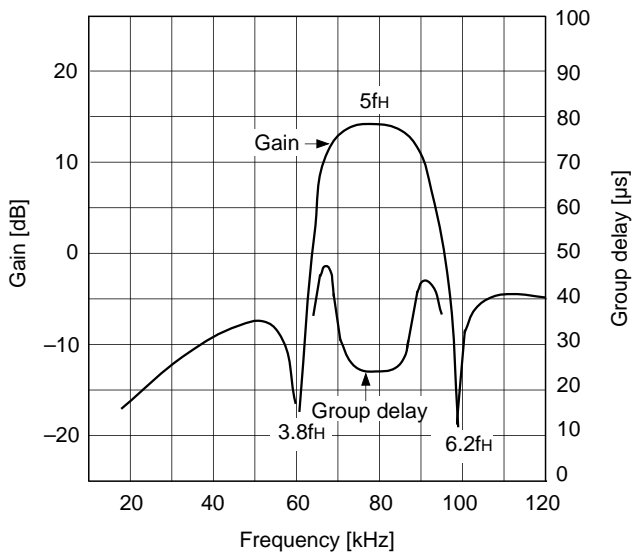
Stereo LPF frequency characteristics



Main LPF and Sub LPF frequency characteristics



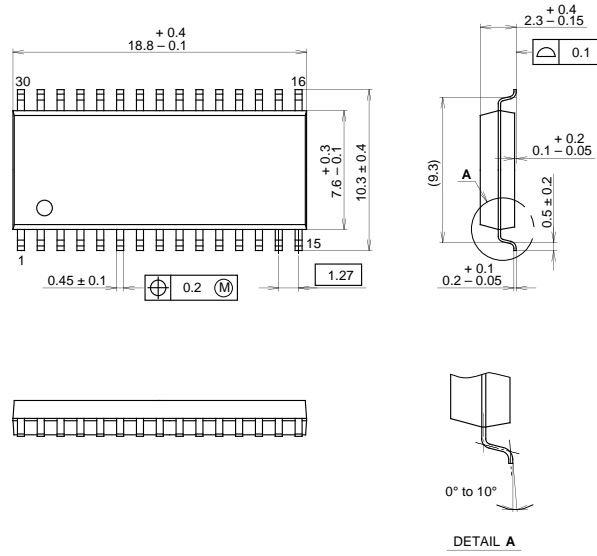
SAP frequency characteristics and group delay



Package Outline

Unit: mm

30PIN SOP(PLASTIC)



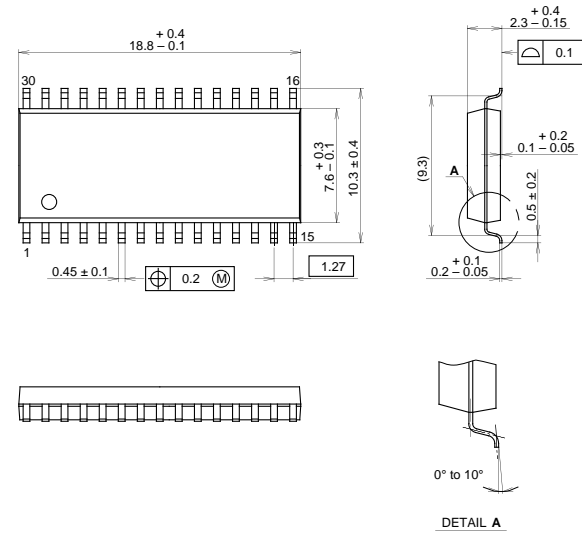
PACKAGE STRUCTURE

| | |
|------------|---------------|
| SONY CODE | SOP-30P-L03 |
| EIAJ CODE | SOP030-P-0375 |
| JEDEC CODE | _____ |

| | |
|------------------|----------------|
| PACKAGE MATERIAL | EPOXY RESIN |
| LEAD TREATMENT | SOLDER PLATING |
| LEAD MATERIAL | COPPER ALLOY |
| PACKAGE MASS | 0.7g |

SCT Ass'y

30PIN SOP(PLASTIC)



PACKAGE STRUCTURE

| | |
|------------|---------------|
| SONY CODE | SOP-30P-L03 |
| EIAJ CODE | SOP030-P-0375 |
| JEDEC CODE | _____ |

| | |
|------------------|----------------|
| PACKAGE MATERIAL | EPOXY RESIN |
| LEAD TREATMENT | SOLDER PLATING |
| LEAD MATERIAL | COPPER ALLOY |
| PACKAGE MASS | 0.7g |

LEAD PLATING SPECIFICATIONS

| ITEM | SPEC. |
|--------------------|-----------------|
| LEAD MATERIAL | COPPER ALLOY |
| SOLDER COMPOSITION | Sn-Bi Bi:1-4wt% |
| PLATING THICKNESS | 5-18µm |