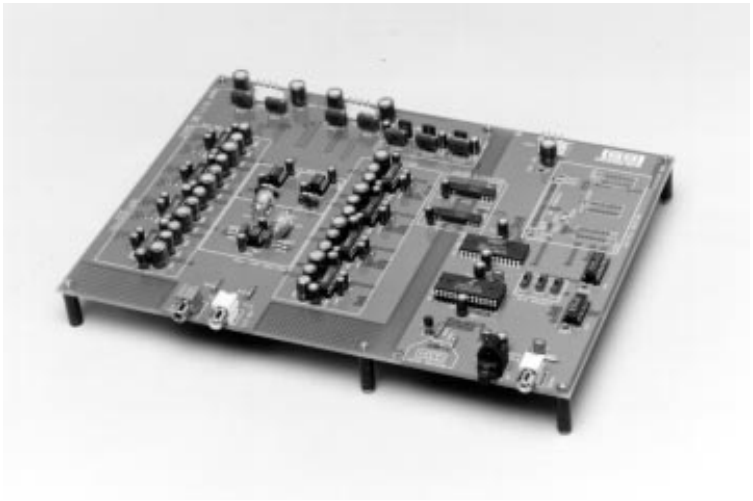
BURR-BROWN®

EVM-1702
EVALUATION MODULE



FEATURES

- **PRECISION DAC BOARD WITH 20-BIT RESOLUTION**
- **STANDARD DIGITAL AUDIO INTERFACE (S/PDIF, EIAJ-1201) OPTICAL OR COAX INPUT**
- **SAMPLING RATE: 32kHz to 48kHz**
- **COMPLETE ISOLATION FOR DIGITAL/ANALOG**
- **HDCD DECODE FUNCTION**
- **8X OVERSAMPLING DIGITAL FILTER**
- **4 PCM1702 DACs PER CHANNEL (connected in parallel)**
- **HIGH PERFORMANCE**
  THD+N: –90dB (16-bit)
  –100dB (20-bit)
  Dynamic Range: 98dB (16-bit, EIAJ)
  112dB (20-bit, EIAJ)
  S/N Ratio: 118dB (EIAJ)
- **2ND-ORDER POST LPF**
- **POWER SUPPLY**
  Digital: +5V
  Analog: ±5V, ±8V, ±15V
- **BOARD SIZE: 297mm X 210mm (A4)**

DESCRIPTION

EVM-1702 is an evaluation module based on Burr-Brown's superior 20-bit DAC, the PCM1702. The system has excellent sound quality and high performance achieved by combining ISO150 digital isolators with high speed op amps OPA627 and OPA2604.

A parallel connection technique has been used where the same left channel (right channel) digital data is sent to four independent PCM1702's whose analog outputs are then combined to produce the left channel (right channel) analog output for the system. As a result, EVM-1702 has superior audio performance, very low THD+N, wide dynamic range and high S/N ratio.

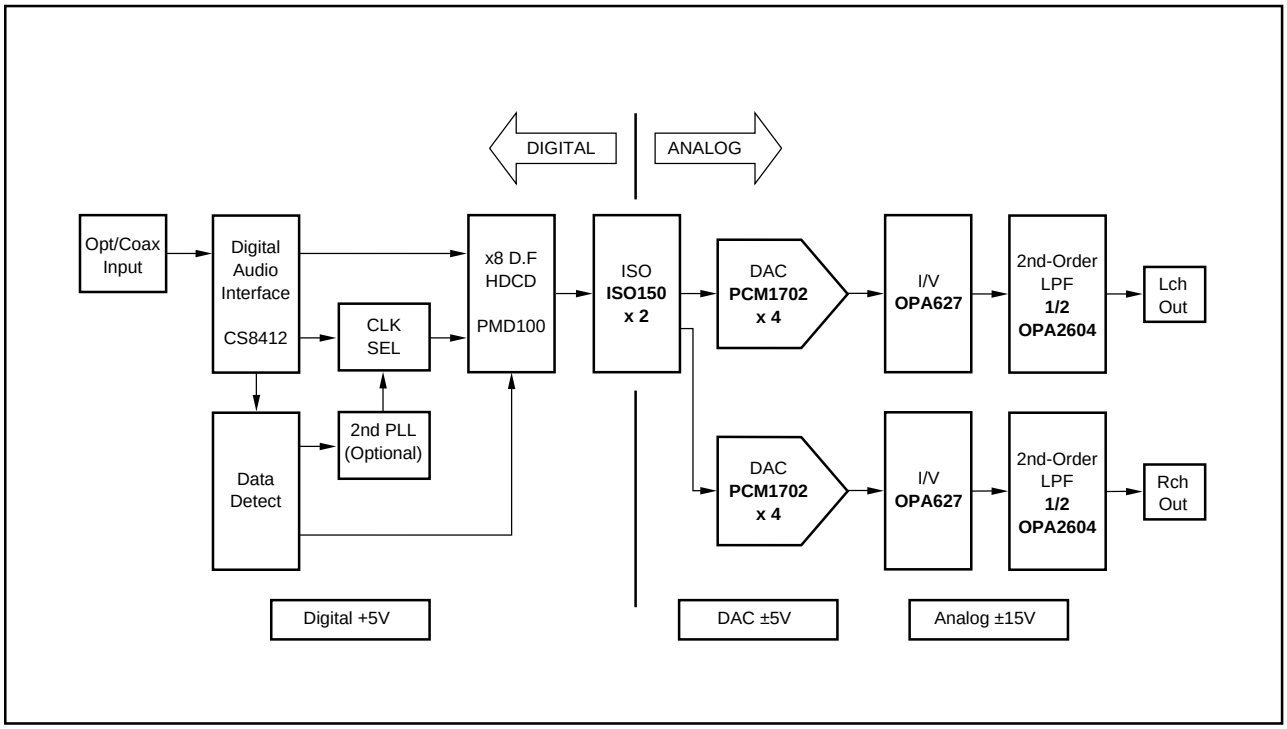
The EVM-1702 is used in conjunction with a HDCD decoder, provided by the Pacific Microsonic Corporation, to play HDCD encoded discs.

EVM-1702 has an optional 2nd PLL circuit (not installed) that can be used for applications with low jitter requirements.

International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111 • Twx: 910-952-1111
Internet: http://www.burr-brown.com/ • FAXLine: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

LI-489 Printed in U.S.A. August, 1997

BLOCK DIAGRAM

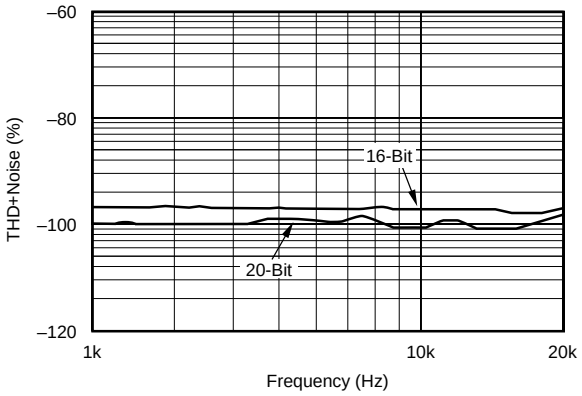


ELECTRICAL SPECIFICATIONS

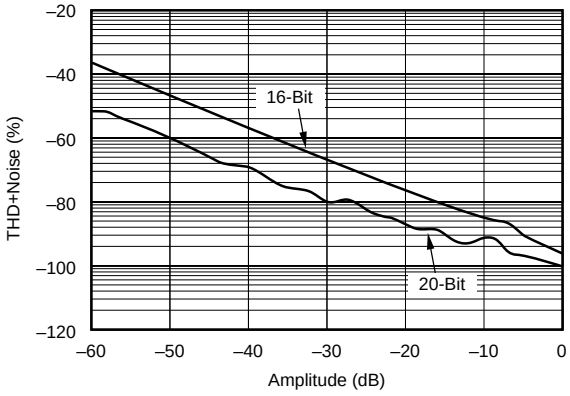
DIGITAL SECTION	
Digital Input:	Standard Digital Audio Interface (S/PDIF, EIAJ, CP2101) Automatic Selection for Optical or Coax
Sampling Rate:	32kHz to 48kHz
Resolution:	20-Bit
Digital Filter:	8X Oversampling with HDCD Decode Function
Digital De-emphasis:	44.1kHz, 48kHz
ANALOG SECTION	
THD+N at 0dB:	16-Bit Data: –97dB typ 20-Bit Data: –100dB typ
Dynamic Range:	16-Bit Data: 98dB typ 20-Bit Data: 112dB typ
SNR (EIAJ):	118dB typ
Analog Output:	2Vrms (normal CD) 1Vrms (HDCD CD)
POWER SUPPLY	
Digital:	+4.5V to +5.5V, 180mA typ, 210mA max
DAC:	±4.75V to ±5.25V, +64mA typ, +88mA max, –200mA typ, –330mA max
Analog:	±8V to ±18V, ±24mA typ, ±27mA max
Operation Temperature Range:	0°C to +70°C

TYPICAL PERFORMANCE CURVES

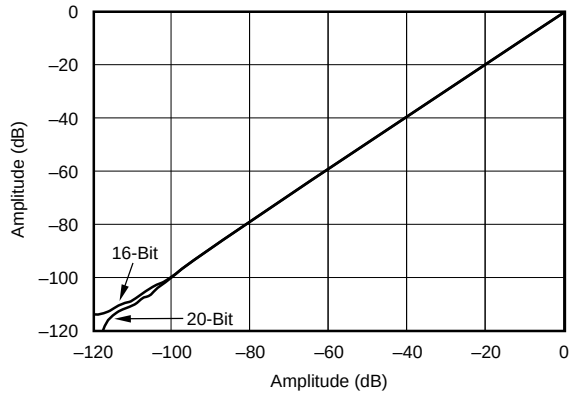
THD+N vs FREQUENCY



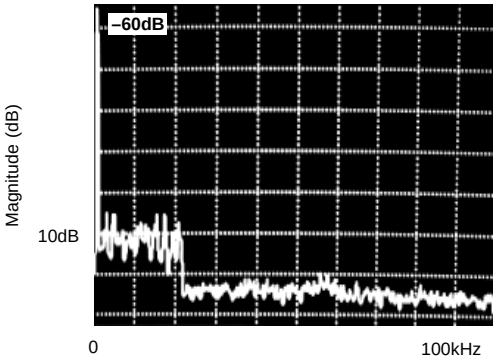
THD+N vs LEVEL



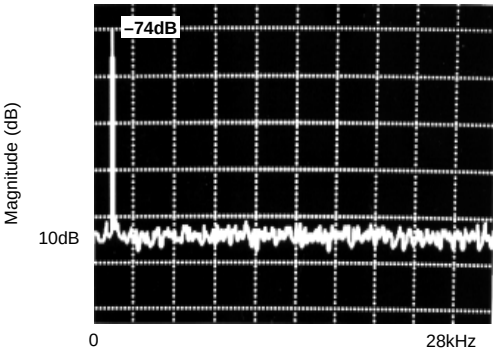
LEVEL LINEARITY



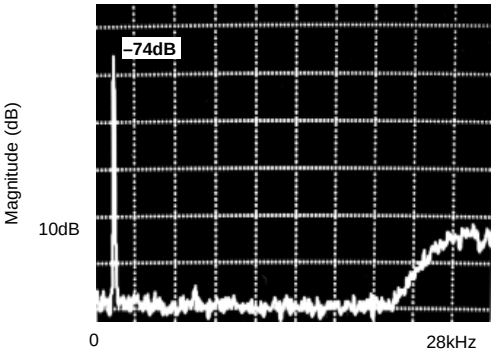
OUTPUT SPECTRUM (BW = 100kHz)
–60dB, f = 1kHz



OUTPUT SPECTRUM (Normal CD)
–74dB, f = 1kHz

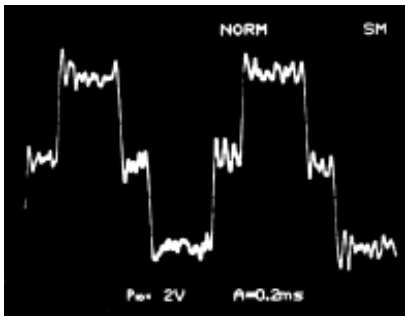


OUTPUT SPECTRUM (HDCD)
–74dB, f = 1kHz

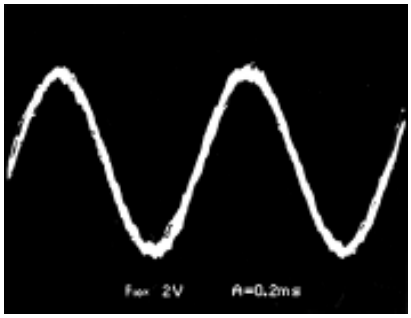


TYPICAL PERFORMANCE CURVES (CONT)

OUTPUT WAVEFORM (16-bit)
–90dB, f = 1kHz

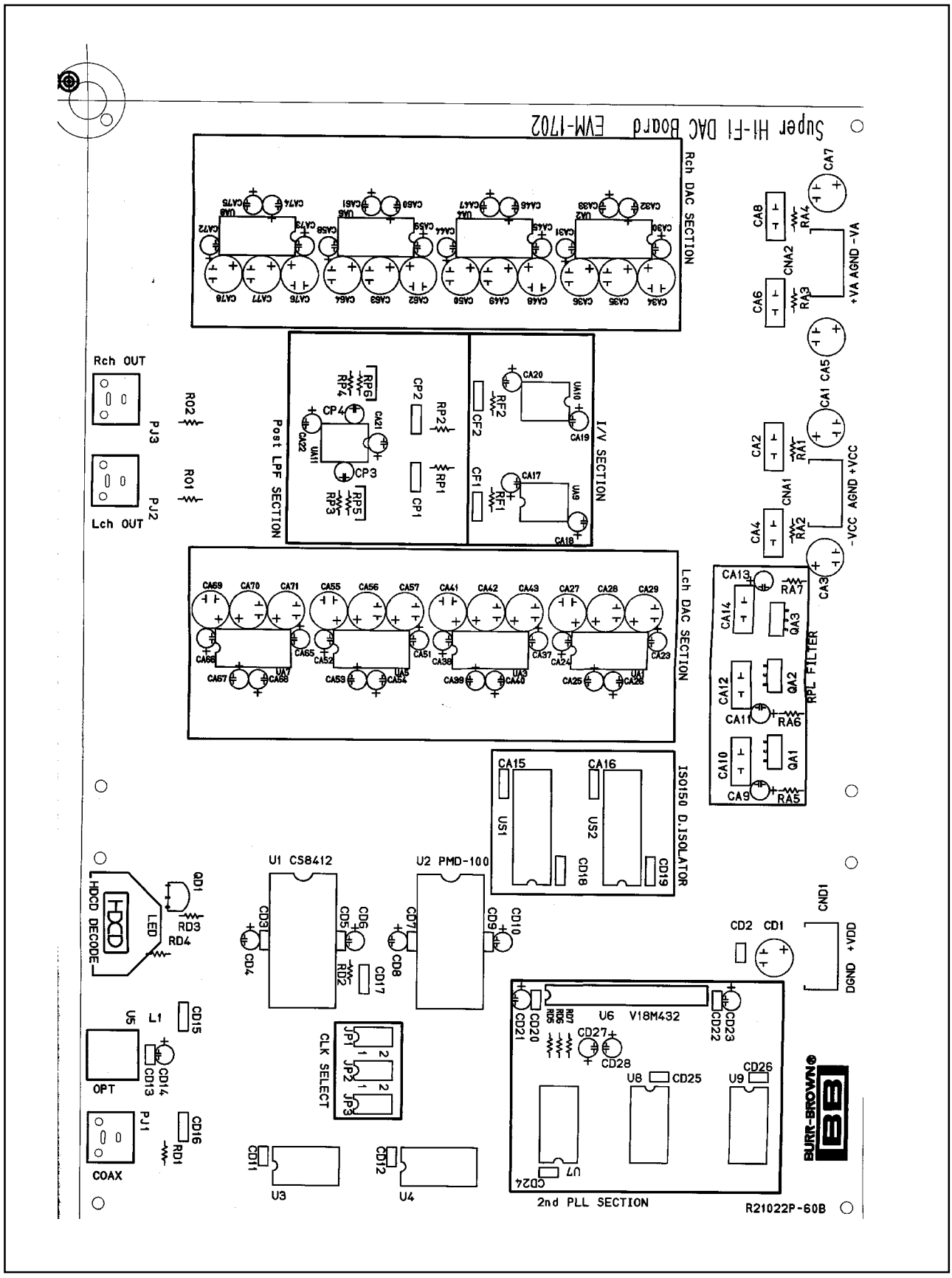


OUTPUT WAVEFORM (20-bit)
–90dB, f = 1kHz



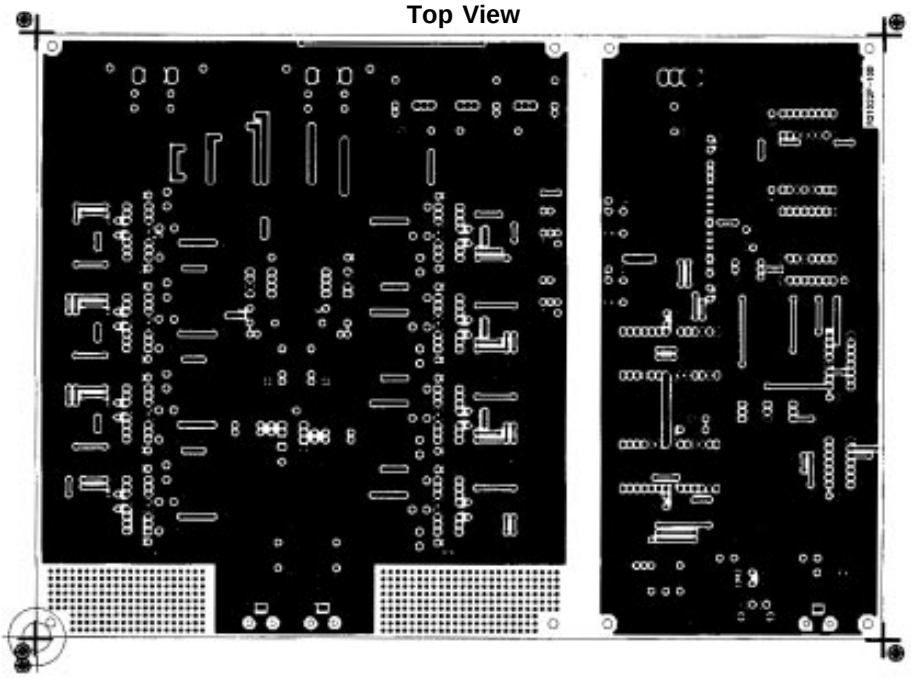
PC BOARD LAYOUT

Parts Location

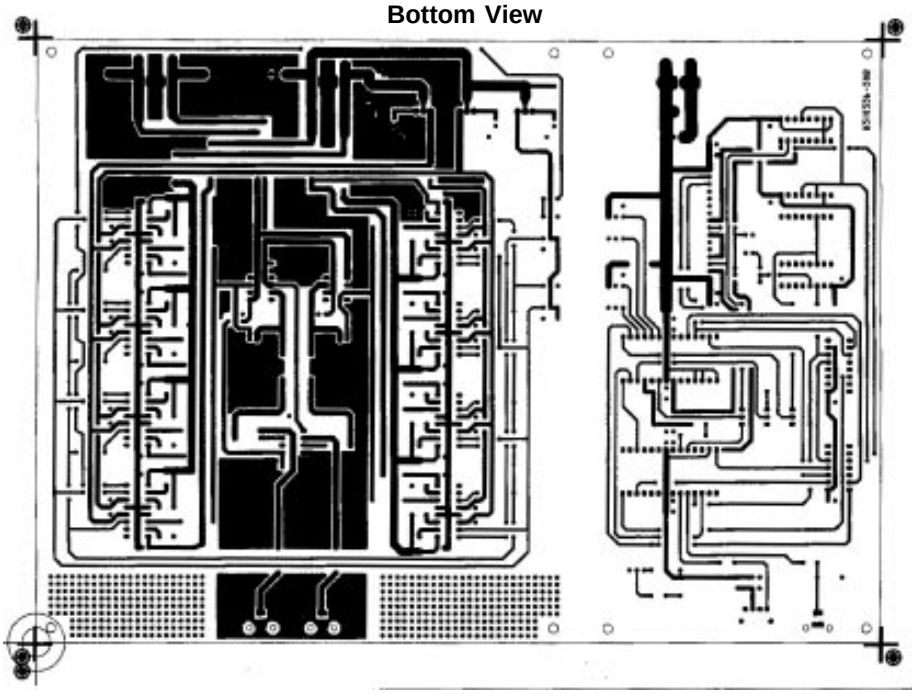


PC BOARD LAYOUT

Top View



Bottom View



THEORY OF OPERATION

The super HiFi DAC board EVM-1702 requires only a power supply and a digital audio input signal. The system outputs a stereo audio signal with excellent sound and performance.

DIGITAL SECTION

The digital section contains a Digital Audio Interface receiver IC (CS8412) and digital filter/HDCD decoder PMD-100. See Figure 1.

The CS8412 generates a $256f_S$ system clock and recovers PCM audio data to provide the PMD-100 with a digital audio input signal. The PMD-100 has two major functions: as an oversampling digital filter and an HDCD decoder which outputs 8X, 20-bit oversampling data to the DAC section.

An external timing circuit containing an HC04 and HC595 detects de-emphasis control and sampling frequency(f_S) information.™

DIGITAL ISOLATOR SECTION

ISO150 is a two-channel isolated data coupler capable of a data rate of 80MB with a 1500V rated isolation voltage.

Any digital noise in the digital section can be completely isolated from the DAC/analog section by the ISO150. The analog section can be operated with a low noise power supply and ground.

DAC SECTION

The PCM1702 has both digital and analog power supply pins. To reject switching noise at the DAC, EVM-1702 uses a ripple filter circuit for power supply filtering. See Figure 5.

Superior performance and sound quality are produced by combining the parallel connection of 4 DACs per channel. This parallel connection technique produces very low THD+N performance (up to –100dB) and wide dynamic range (up to 112dB). The user may configure the system with up to 4 PCM1702s per channel. The parallel connection of 'N' PCM1702s (where 'N' = 1, 2, 3, 4) can be determined by the user. Feedback resistors RF_1 and RF_2 in the I/V section should be changed according to the number ('N') of PCM1702 DACs. The output voltage (Vp-p) is given by the following equation:

$$Vp\text{-}p = \pm 1.2mA \times N \times RF_{1,2}$$

I/V SECTION

The high speed Difet® OPA627 is the best op amp for the I/V amp section due to its high speed settling, slew rate, low THD+N, and low noise performance. The feedback resistor (RF) provides an output voltage as described in the DAC section. The feedback capacitor (CF) determines the closed-loop cut-off frequency.

SECOND-ORDER POST LPF SECTION

After I/V conversion, the output signal still contains out-of-band noise. In order to reject this out-of-band noise, EVM-1702 uses a 2nd-order inverting, active low pass filter with an OPA2604 (see Figure 4). The OPA2604 has superior sound quality with very low THD+N performance. This dual op amp is designed for high performance audio applications. The cut-off frequency of this LPF is designed to 80kHz where the digital filter has more than 100dB stopband attenuation.

Optional 2nd PLL

The dynamic performance of the D/A conversion system is influenced by clock jitter and the sensitivity of this jitter is mainly given by the architecture of the D/A converter. The EVM-1702 uses a low jitter digital audio interface receiver (CS8412), in conjunction with a multi-bit DAC (PCM1702), to achieve superior performance without the use of a re-clocking circuit.

The EVM-1702 has an optional 2nd PLL circuit (not installed) which can be populated if the user so chooses. Refer to Figure 1. The clock selection can be controlled by JP1 through JP3, normally set to side 1.

OPTIONAL SINGLE-ORDER POST LPF

Instead of a 2nd-order low pass filter, a simple 1st-order, RC passive low pass filter may be constructed. The filter is composed of $RP_{1,2}$ and $CP_{1,2}$, which can be calculated by the following formula:

$$f_C = \frac{1}{(2\pi)\,(RP_{1,2})\,(CP_{1,2})}$$

NOTE: When using a single-order RC circuit on the EVM-1702, the OPA2604 must be removed and resistors $RP_{5,6}$, should be replaced with 0Ω resistors (short circuits). Sound quality differences between the 1st-order RC filter response versus a 2nd-order active filter response are objective and should be decided by the user.

HDCD Decoder

The HDCD decoded output signal level is 6dB lower than the normal CD output due to HDCD encoding/decoding architecture.

Normal CD: 2Vrms typ

HDCD CD: 1Vrms typ

In general, this 6dB loss can be compensated by any gain control circuit. In the case of the EVM-1702, it does not include a compensation circuit for the 6dB loss due to noise or distortion considerations of the overall system.

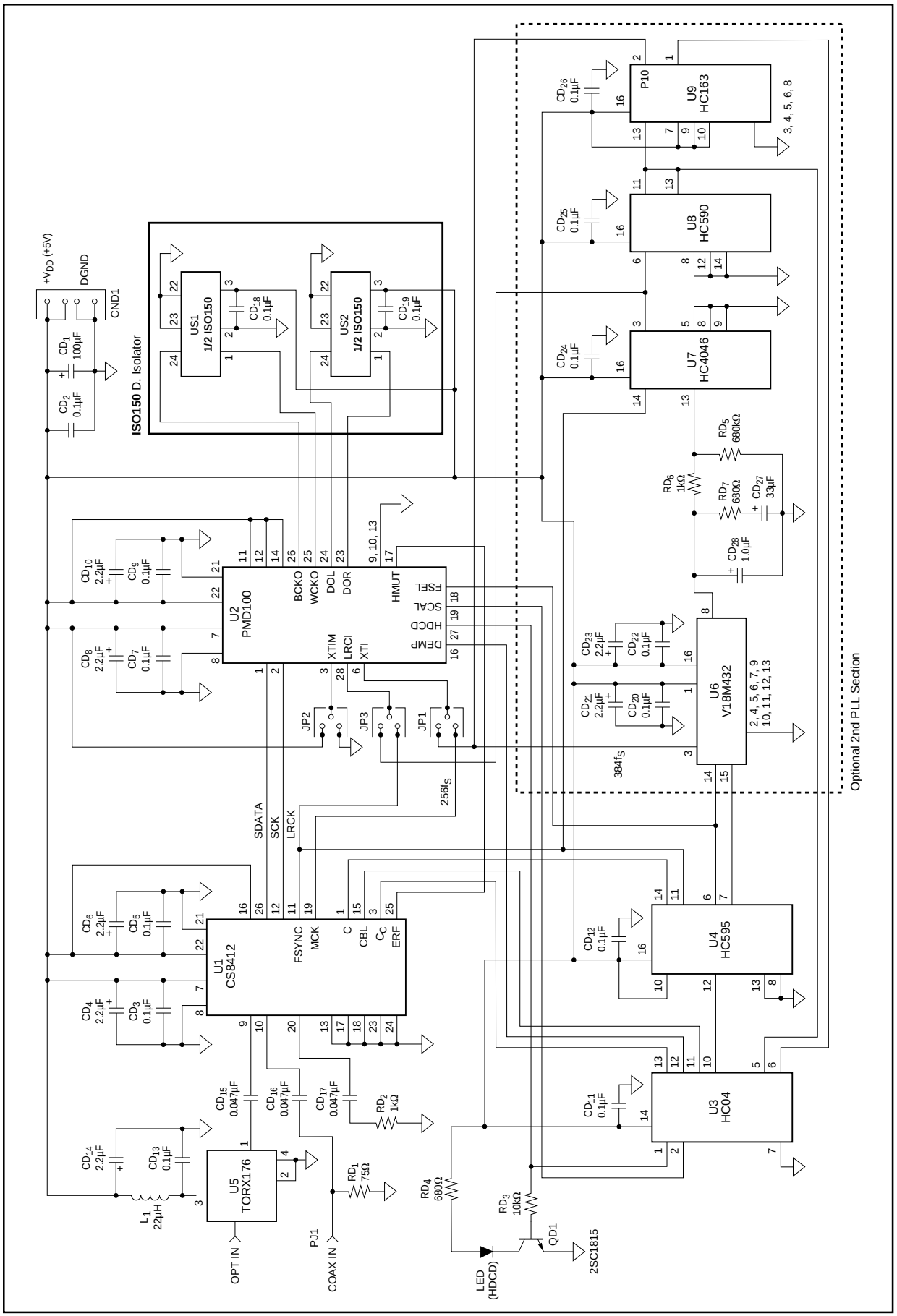


FIGURE 1. Schematic Diagram for Digital Section.

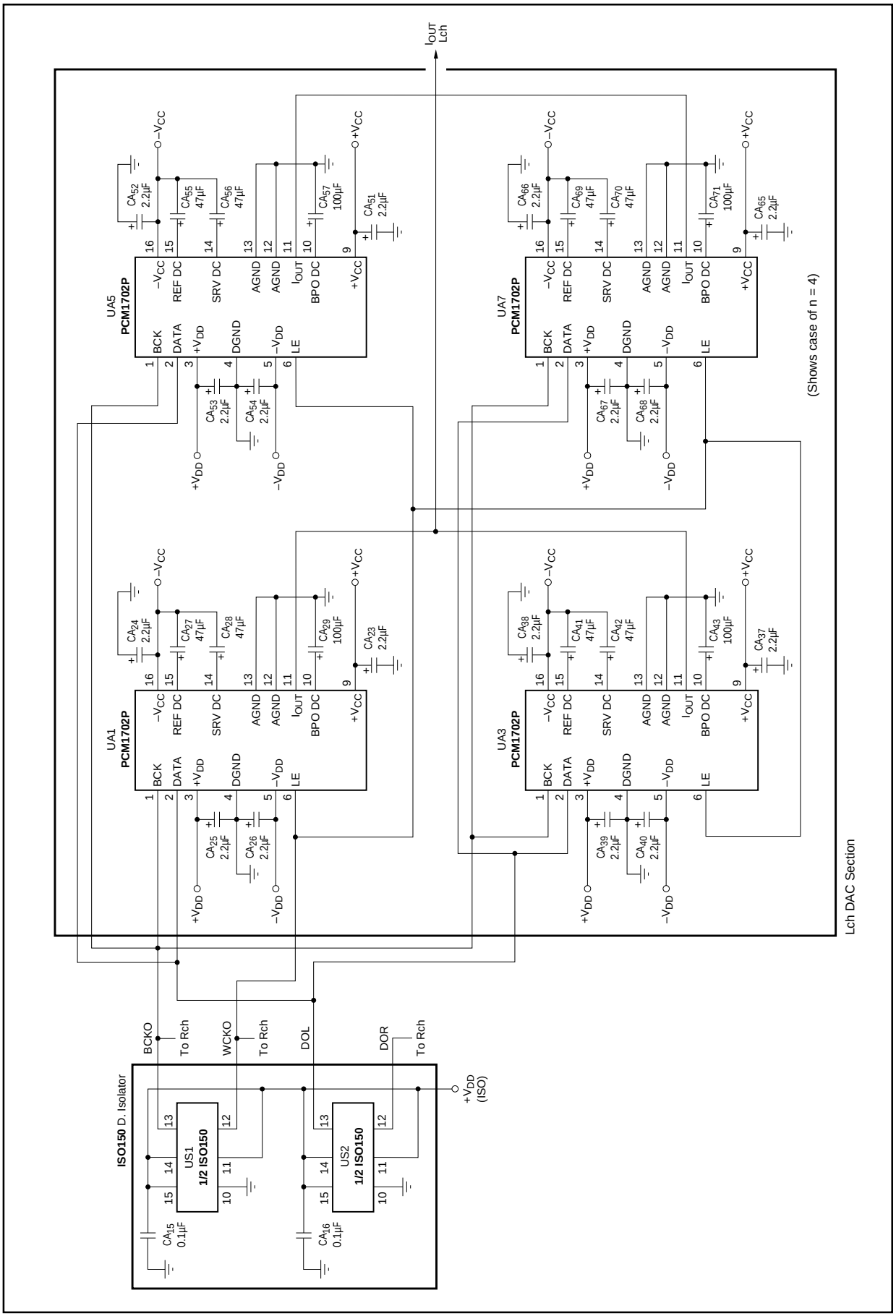


FIGURE 2. Schematic Diagram for PCM1702 Parallel Connection (Lch).

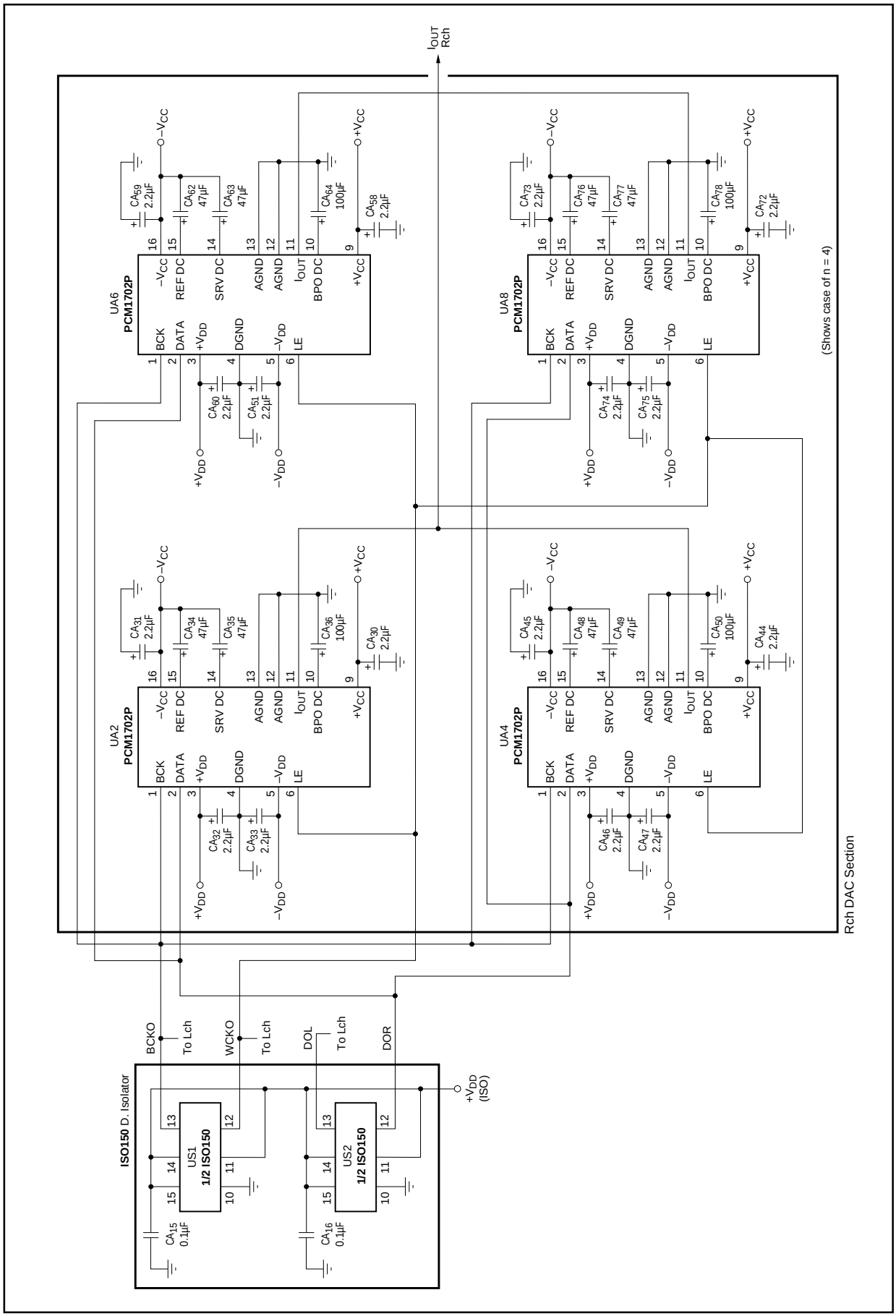


FIGURE 3. Schematic Diagram for PCM-1702 Parallel Connection (Rch).

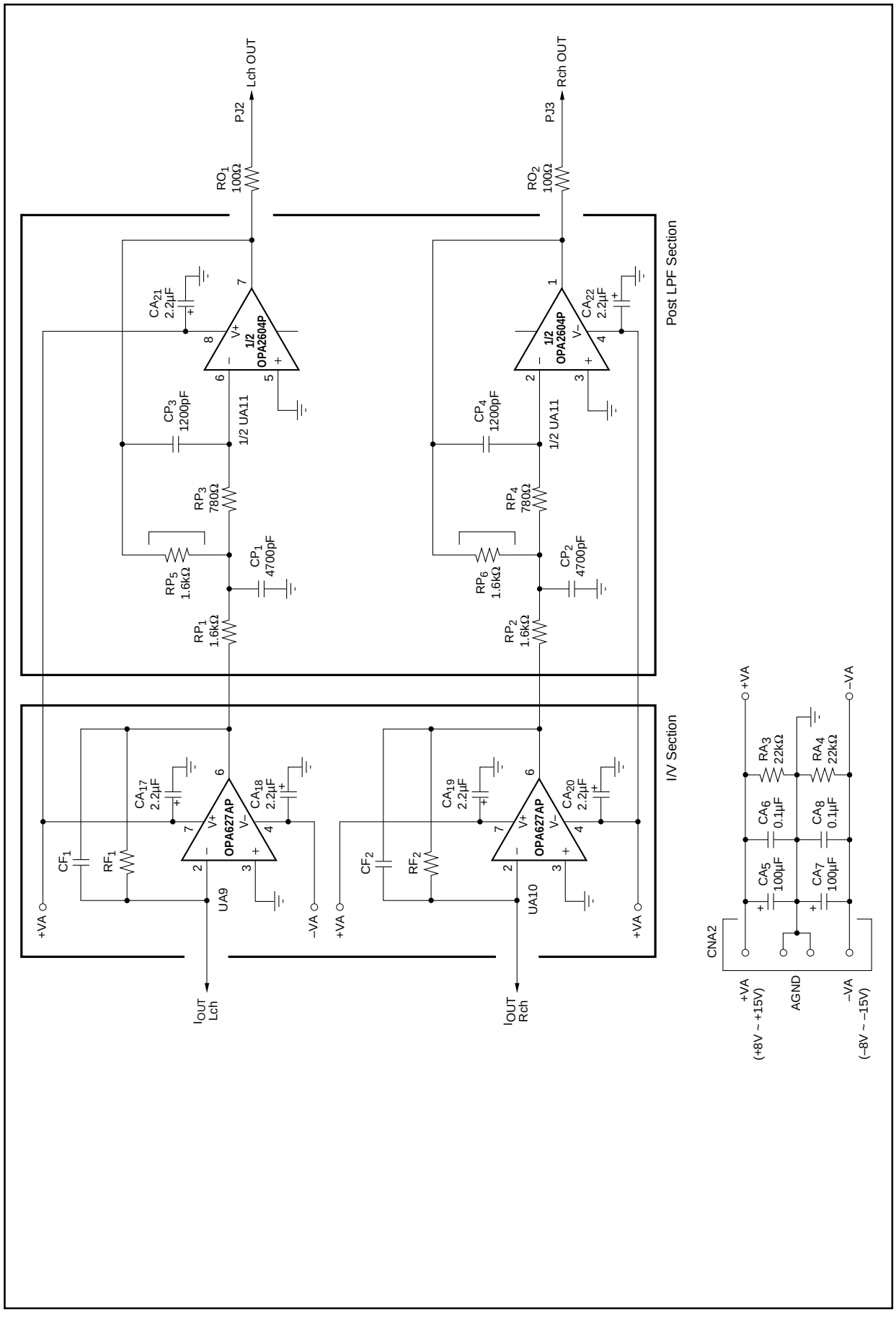


FIGURE 4. I/V Post LPF Section.

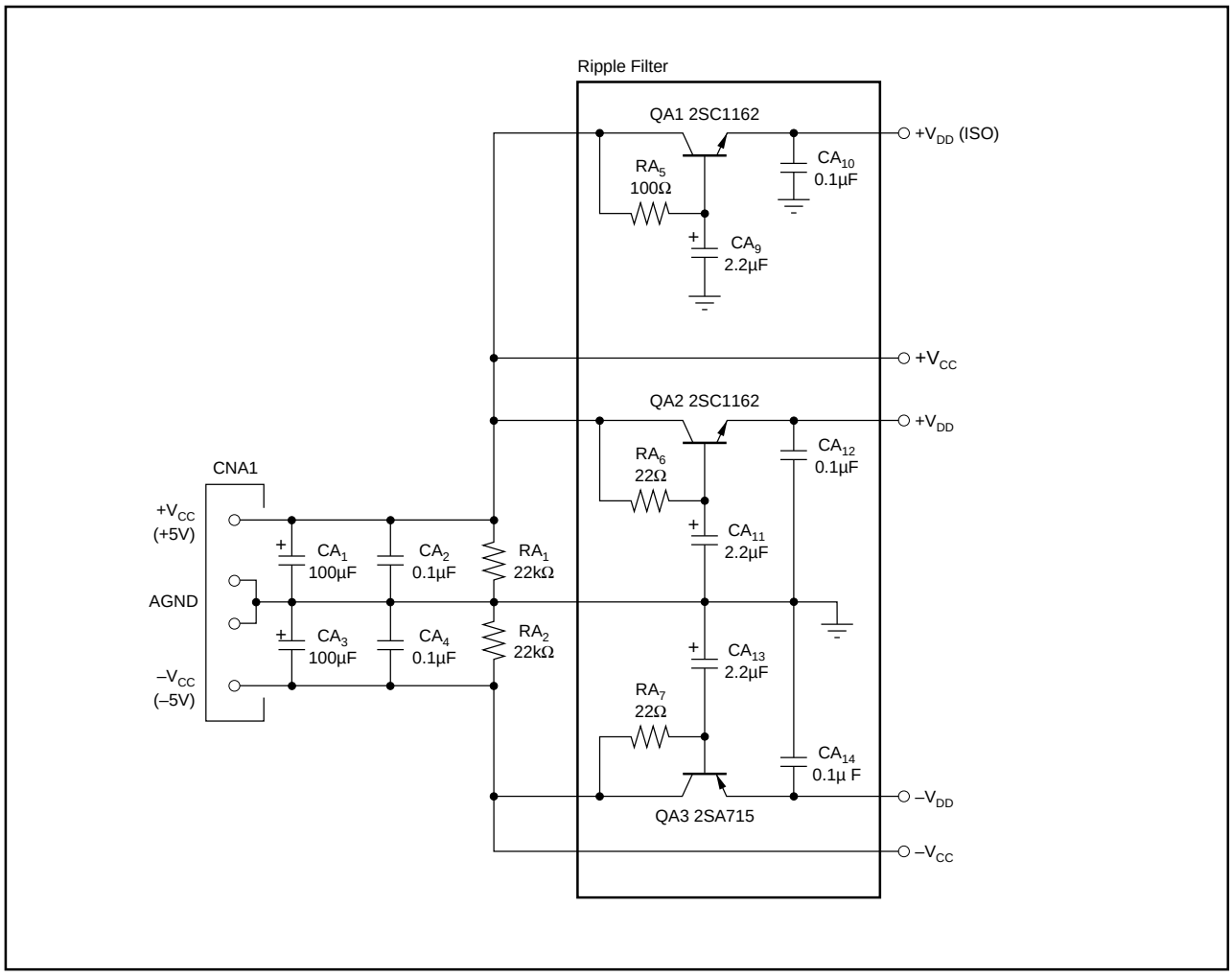


FIGURE 5. Ripple Filter Schematic.

PARTS LIST

REFERENCE DESIGNATOR	PART NUMBER	DESCRIPTION	MANUFACTURER
CND1	B4P-VH	VH Connector	Nippon Acyaku
PJ1	LRP-6520-0804	RCS Pin Jack	SMK
JP1, 2, 3	AP12HP	Single Switch	Nippon Kaiheiki
CD1	ARA16V100µF	Cerafine	Elna
CD2, 3, 5, 7, 9, 11, 12, 13, 18, 19	D55Y5V1H104A	Ceramic Capacitor 0.1µ50F	NEC
CD4, 6, 8, 10, 14	ARA50V2.2µF	Cerafine	Elna
CD15, 16, 17	AFA Series	Film Capacitor 0.047µF50V	Nissei
RD1	RD Series	M.R 75Ω 1/4W	Kamaya
RD2	RD Series	1kΩ	Kamaya
RD3	RD Series	10kΩ	Kamaya
RD4	RD Series	820Ω	Kamaya
L1	EL0606 Series	22µH Inductor	TDK
QD1	2SC1815	NPN TR	
LED		LED (RED)	
U1	CS8412	DAC Receiver	Crystal
U2	PMD100	DF, HDCD	Pacific Microsonic
U3	HC04	CMOS IC	
U4	HC595	CMOS IC	
U5	TORX176	OPT Tos Link	Toshiba
US1, 2	D. Isolator	ISO150AP	Burr-Brown
CNA1, 2	B4P-VH	VH Connector	Nippon Acyaku
PJ2	LPR6520-0803	RCA Pin Jack	SMK
PJ3	LPR6520-0802	RCA Pin Jack	SMK
CA1, 3, 5, 7	ARA25V100µF	Cerafine	Elna
CA2, 4, 6, 8, 10, 12, 14, 15, 16	MTFF104 50V.DC	Film Capacitor	Nissei
CA9, 11, 13, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31, 32, 33, 37, 38, 39, 40, 44, 45, 45, 47, 51, 52, 53, 54, 58, 59, 60, 61, 65, 66, 67, 68, 72, 73, 74, 75	ARA50V2.2µF	Cerafine	Elna
CA27, 28, 34, 35, 41, 42, 48, 49, 55, 56, 62, 63, 69, 70, 76, 77	ARA16V47µF	Cerafine	Elna
CA 29, 36, 43, 50, 57, 64, 71, 78	ARA16V100µF	Cerafine	Elna
CF1, 2	DM10 100PF100V	Silvered Mica Capacitor	Nittsukou
CP1, 2	APF472 (J)	Film Capacitor 4700P	Nissei
CP3, 4	APF122 (J)	Film Capacitor 1200P	Nissei
RF1, 2	RD Series	M.R 680Ω 1/4W	Kamaya
RP1, 2, 5, 6	RD Series	1.6kΩ	Kamaya
RP3, 4	RD Series	780Ω	Kamaya
RO1, 2	RD Series	100Ω	Kamaya
RA1, 2, 3, 4	RD Series	22kΩ	Kamaya
RA5	RD Series	100Ω	Kamaya
RA6, 7	RD Series	22Ω	Kamaya
QA1, 2	2SC1162	NPN TR	
QA3	2SA715	PNP TR	
UA1, 2, 3, 4, 5, 6, 7, 8	PCM1702P-K	16-Pin IC Socket	Burr-Brown
UA9, 10	OPA627AP	Op Amp	Burr-Brown
UA11	OPA2604AP	Op Amp	Burr-Brown