TL7230MD
Application Note

Rev. 0.2
September, 1999

1. Application Overview

This application note targets a MP3 player system that receives and decodes MP3 bit stream. It also supports recording and reproducing voice signals. It consists of TL7230MD, a microcontroller, flash memory ICs, LCD, and keypad. The following figure shows how all the components are configured.

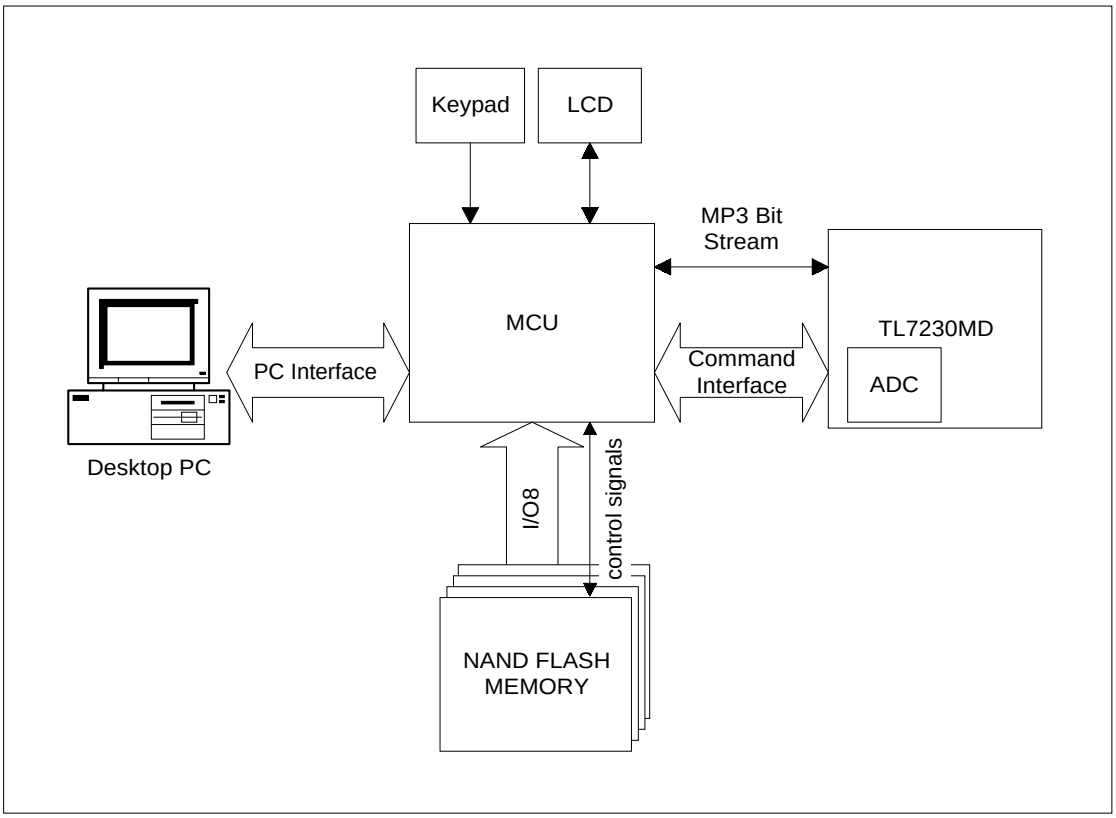

Figure 1. MP3 Player System Configuration

TL7230MD is a single chip ISO/IEC 11172-3 audio layer 3 decoder developed by TLI Inc. It receives and decodes MP3 bit stream. The microcontroller controls all the system operations such as checking of status changes of keypad, sending commands or MP3 bit stream to TL7230MD, managing data storage ICs, and communications with LCD. NAND-type flash memory ICs are used as data storage, and they store compressed voice data as well as MP3 bit stream data. LCD and keypad are used for user interface.

This application note is written for system users who want to design a MP3 player system using TL7230MD. Figure 2 shows the functional block diagram of TL7230MD. For CPUXI and CPUXO, 16.9344MHz crystal oscillator can be connected as in Figure 2. Providing 16.9344MHz clock source to CPUXI with floating CPUXO is also possible. For MP3 bit stream, request line(REQSTRM), clock(CLKXRM), and data(DXRM) lines should be connected properly. Data is

transferred serially with one byte at a time.

To give a command to TL7230MD, HIP(Host Interface Port) should be used. It requires that HSEL#, HALE, HRD#, HWR#, and HD[7:0] should be driven properly as indicated in the datasheet of TL7230MD. The available commands can also be found in datasheet of TL7230MD.

To use the internal ADC, appropriate analog signal should be applied to ADCAIN. The reference circuit is shown in the application circuit. System users should refer the datasheet of TL7230MD for the external DAC interface.

For system reset, active high RESET should be used. It is recommended that RESET signal should be driven by MCU and be activated each time after exiting power management mode. For the power management mode, refer to datasheet of TL7230MD.

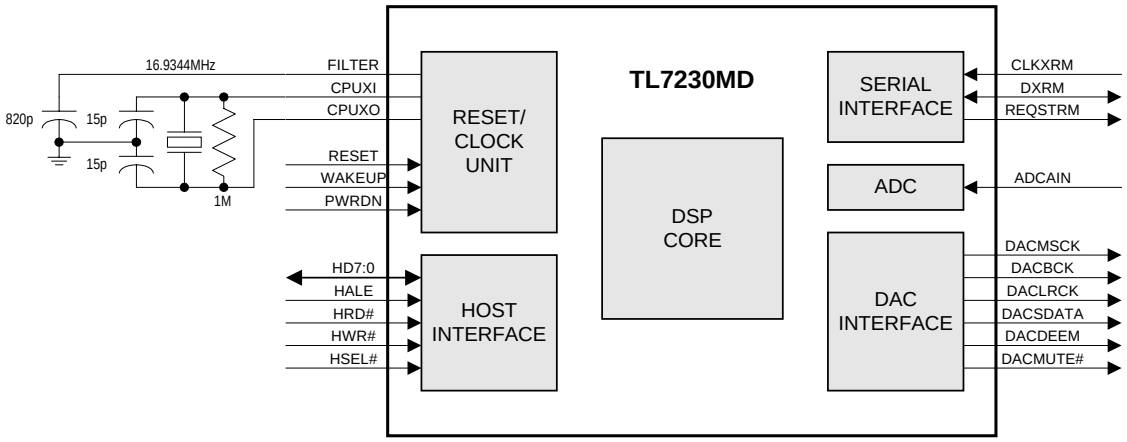

Figure 2. Functional Block Diagram of TL7230MD

2. TL7230MD Features

- Single-chip ISO/IEC 11172-3 Layer III Audio Decoder
- Supports All MPEG Bit Rates Including Free Format
- Supports 32/44.1/48KHz Sampling Frequencies for MPEG Bit Stream
- Supports Single Channel, Dual Channel, Stereo, and Joint Stereo
- Any Combination of Intensity Stereo and MS Stereo is supported.
- Serial Bit Stream Input
- 8-bit Host Interface Port
- Digital Volume Control
- Digital Bass/Treble Control
- 6-band Equalizer Function
- Voice Record/Playback Capability
- Supports Off-chip DAC Interface
- On-chip ADC with 12-bit Resolution
- Power Management to Reduce Power Consumption
- PLL for Internal Clocks and for Output PCM Clock Generation
- Single 16.9344MHz External Clock Input
- 2.7 V Operation

3. Reference Board

In this application note, a reference board design is described to show how the user can develop MP3 player system application based on TL7230MD, MPEG1 audio layer3 decoder. The design uses PICmicro PIC16C74B MCU for system controller, and KM29U128T flash memory for storage of MPEG audio and voice data. PCM1717E is used for audio DAC. To upload or download files to/from PC, parallel port interface is used.

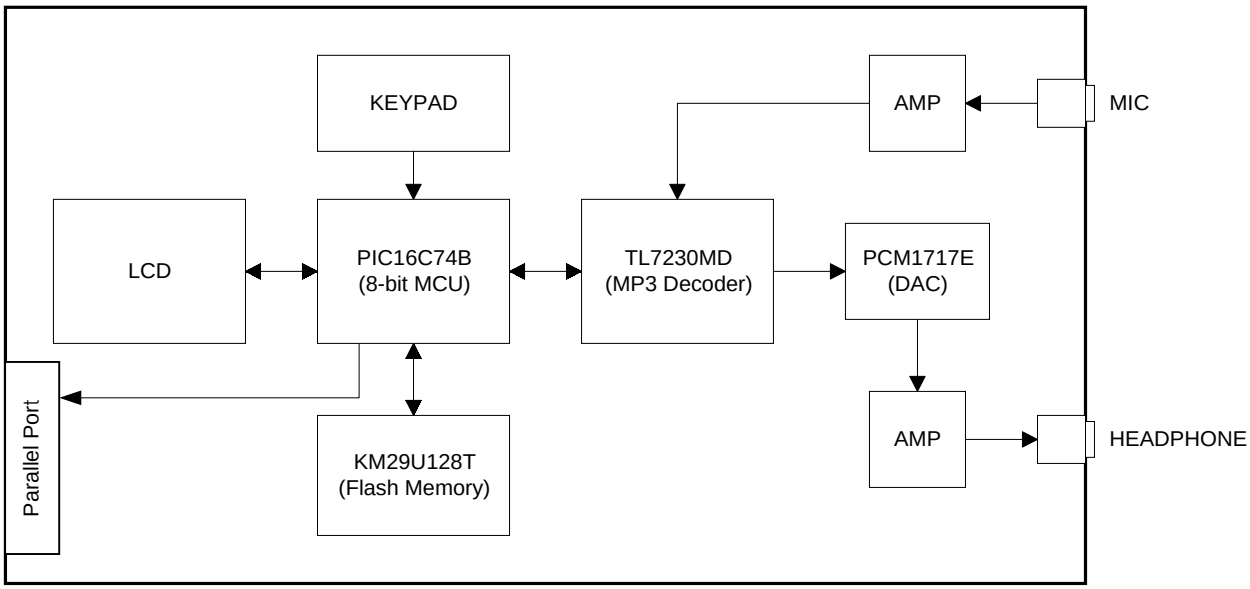

Figure 3. Block Diagram of TL7230MD Reference Board

3.1 General Description

- This board is for reference only. TLI assumes no responsibility for the consequences of use of the reference board to commercial mass production.
- The power, ground and clock routing should be done very carefully to minimize crossing of signals, noise coupling and high frequency radiation.
- 2 power level are used; 4V and 2.7V.
  (4V is used for OP amp and analog circuit. 2.7V is used for others.)
- 3.5mm jack is used for microphone input and headphone output.

3.2 Key Functions

Key	Operations
Play	Decode MP3 bit stream or compressed voice data.
Rec	Receive voice data and compress to store it.
Stop	Stop playing operation.
Prev	Previous music or voice data will be played.
Next	Next music or voice data will be played.
2nd	Enter 2nd function mode.
Vol++	Increase volume.
Vol--	Decrease volume.
Mute (2^{nd} + Play)	Mute.
Del (2^{nd} + Stop)	Delete the specified file.
Bass Boost On/Off (2^{nd} + Vol++)	Start/Stop base boosting. (Toggling operation)

3.3 Component List

Item	Quantity	Designator	Part Value	Manufacturer / Part Type
1	26	BC101-BC119, C102, C104, C106, C108, C125, C127, C149	0.1uF	C1608
2	15	C101, C103, C105, C107, C109, C116, C118, C120, C121, C124, C126, C131, C132, C157, C158	10uF	Solid Tantal Chip Capacitor Type A
3	1	C110	820pF	C1608
4	2	C111, C112	30pF	C1608
5	2	C113, C155	10pF	C1608
6	1	C114	2.2u	Solid Tantal Chip Capacitor Type A
7	2	C115, C117	390p	C1608
8	1	C119	2200pF	C1608
9	2	C122, C123	4.7uF	Solid Tantal Chip Capacitor Type A
10	1	C152	22uF	Solid Tantal Chip Capacitor Type B
11	3	C146, C154, C160	100uF	Solid Tantal Chip Capacitor Type C
12	1	C159	470uF	Electrolytic Capacitor
13	2	C129, C156	330pF	C1608
14	13	C133-C145	100pF	C1608
15	5	C147, C148, C150, C151, C153	0.33uF	C1608
16	2	C128, C130	2700pF	C1608
17	8	D101-D108	1N4148	
18	1	D109	1N5817	DIODE SCHOTTKY, 1A
19	1	D110	DIODE LED	
20	1	J1	DCON25M	
21	2	J101, J102	PHONE JACK(5P)	
22	1	J110	BATTERY1.5	
23	5	J105, J106, J107, J108, J111	Jumper 2-pin	
24	1	L101	2.2uH	
25	3	L102, L103, L106	47uH	
26	11	R101, R102, R107, R108, R111, R112, R153, R158-R161	100KΩ	R1608
27	1	R103	1MΩ	R1608
28	3	R104, R106, R110	8.2KΩ	R1608
29	5	R113, R137, R140, R152, R162	470Ω	R1608
30	2	R105, R109	2.7KΩ	R1608
31	1	R163	4.7KΩ	R1608
32	14	R121-R134	100Ω	R1608
33	9	R114, R116, R119, R135, R136, R138, R139, R149, R150	10KΩ	R1608

34	1	R151	250KΩ	R1608
35	1	R154	220KΩ	R1608
36	2	R117, R120	3.9KΩ	R1608
37	2	R115, R118	5.6KΩ	R1608
38	1	R155	180KΩ	R1608
39	2	R156, R157	200KΩ	R1608
40	8	S101-S108	TACT(S)	
41	1	S109	PUSH6P	
42	1	U101	TL7230MD	TLI TL7230MD
43	1	U102	PCM1717	Burr-brown PCM1717E
44	1	U103	PIC16C74	PICmicro 16C74B
45	1	U104, U110	OPA2340	
46	1	U105	74LPT374	
47	2	U106, U107	KM29U128T	Samsung KM29U128T
48	1	U108	74LPT245	
49	1	U109	74LPT244	
50	1	U111	MAX1705	Maxim MAX1705
51	1	U112	74LPT04	
52	1	U113	LCD	
53	1	X101	XTAL, 16.9344M	
54	1	X102	XTAL, 20M	

3.4 PIC16C74B Pin Assignment

Pins	Function	Pins	Function
RA0	DXRM	RC3	Flash_CE1#
RA1	DXRM	RC4	Flash_RD#
RA2	CLKXRM	RC5	Flash_WR#
RA3	Key	RC6	Flash_R/B#
RA4	REQSTRM	RC7	PWRDN
RA5	WAKEUP	RD0	D[0]
RB0	EPP_Reset	RD1	D[1]
RB1	EPP_nDStrobe	RD2	D[2]
RB2	EPP_nAStrobe	RD3	D[3]
RB3	EPP_Interrupt	RD4	D[4]
RB4	EPP_nWait	RD5	D[5]
RB5	HIP_HSEL#	RD6	D[6]
RB6	HIP_LD	RD7	D[7]
RB7	HIP_HALE	RE0	LCD_E
RC0	Flash_CLE	RE1	LCD_RW
RC1	Flash_ALE	RE2	LCD_RS
RC2	Flash_CE0#		

NOTE: HIP_RD#, HIP_WR#, and RESET signals are implemented with 74LS374.

3.5 Parallel Port Pin Configuration

Pins	Function	Pins	Function
1	PCDATA_DIR	14	EPP_nDStrobe
2	D[0]	15	NC
3	D[1]	16	EPP_Reset
4	D[2]	17	EPP_nAStrobe
5	D[3]	18	GND
6	D[4]	19	GND
7	D[5]	20	GND
8	D[6]	21	GND
9	D[7]	22	GND
10	EPP_Interrupt	23	GND
11	EPP_nWait	24	GND
12	GND	25	GND
13	NC		

3.6 Application Circuit

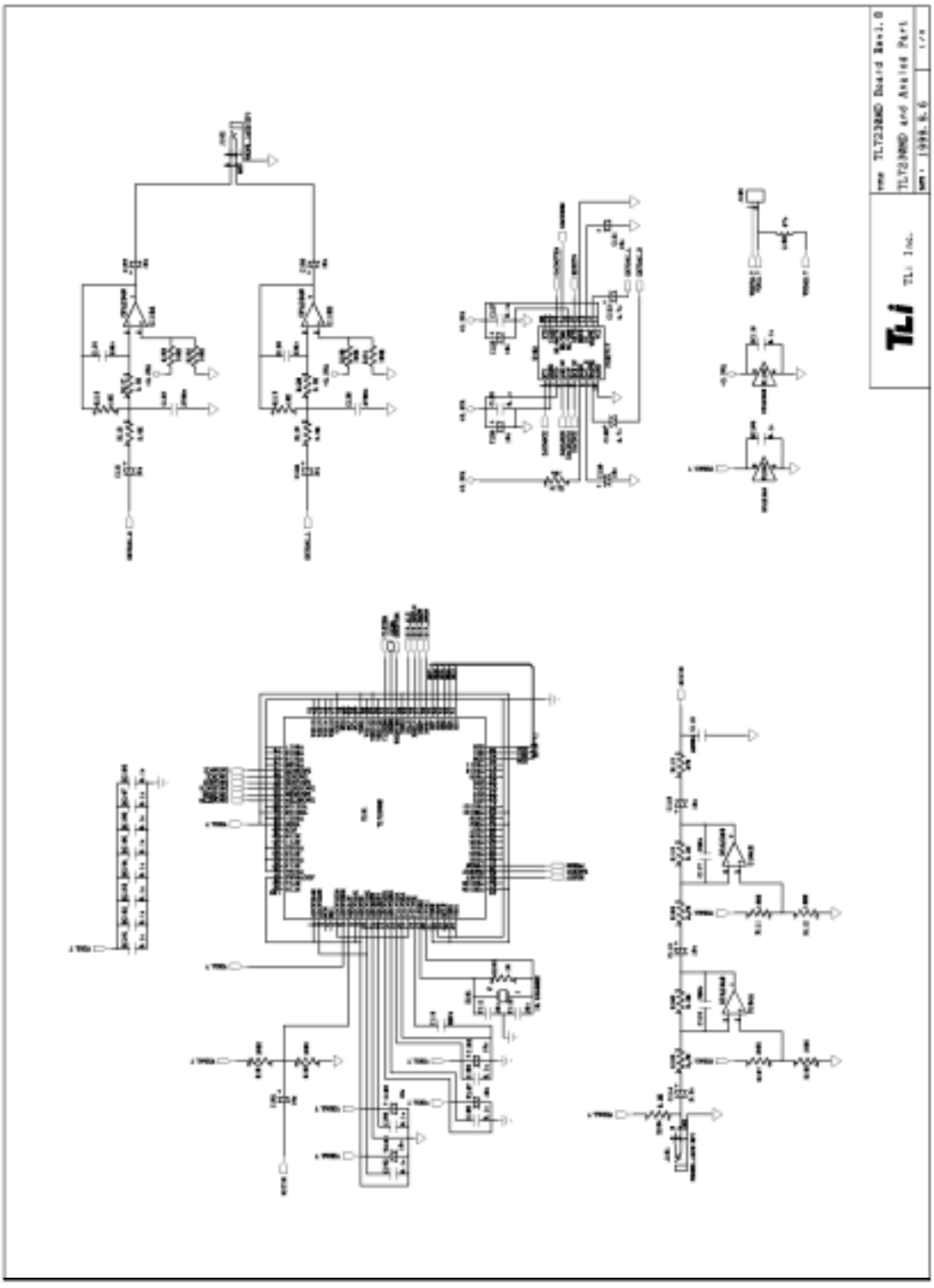

Figure 4. TL7230MD Reference Board - TL7230MD & Analog Part

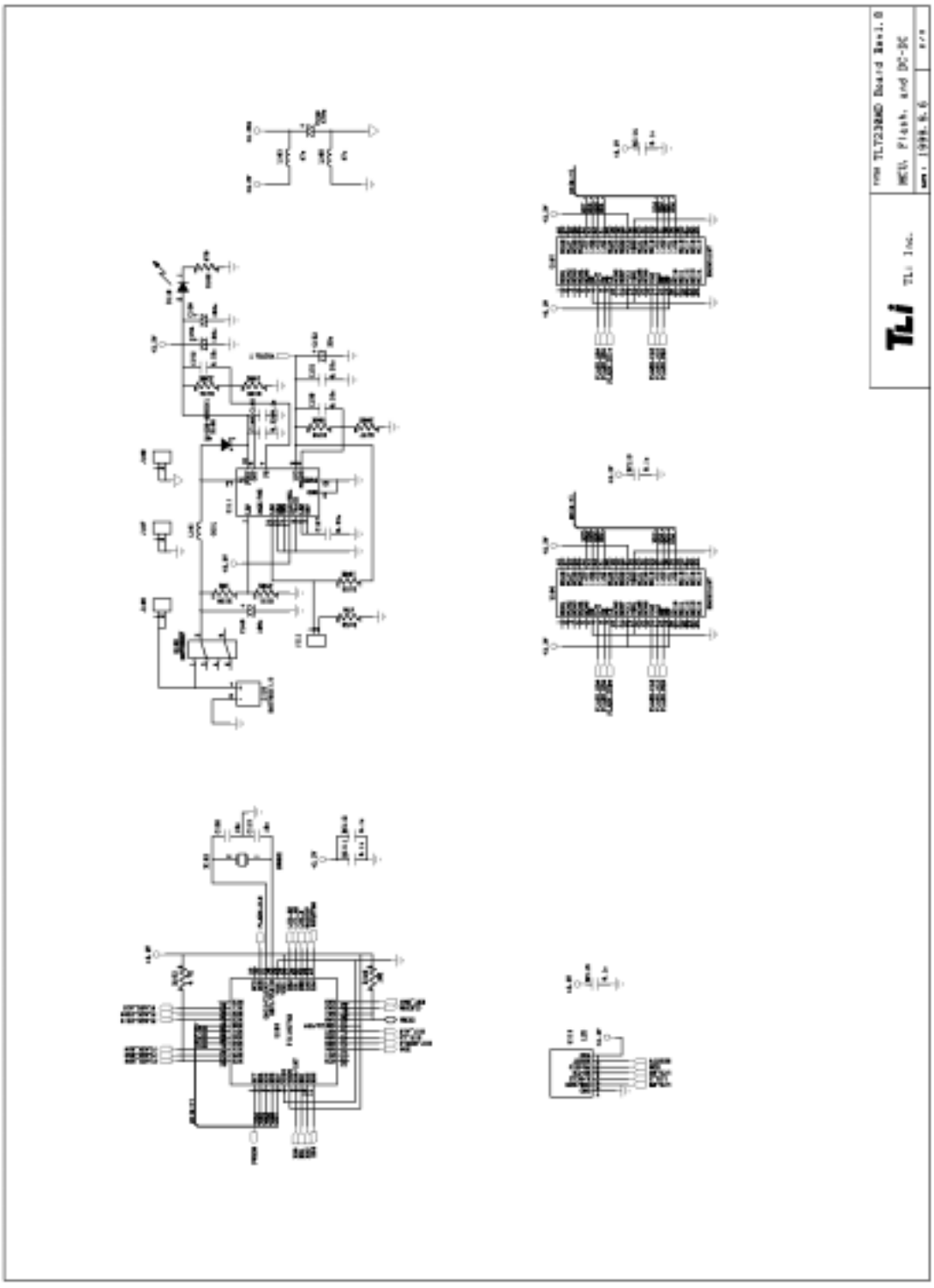

Figure 5. TL7230MD Reference Board – MCU & Flash Memory

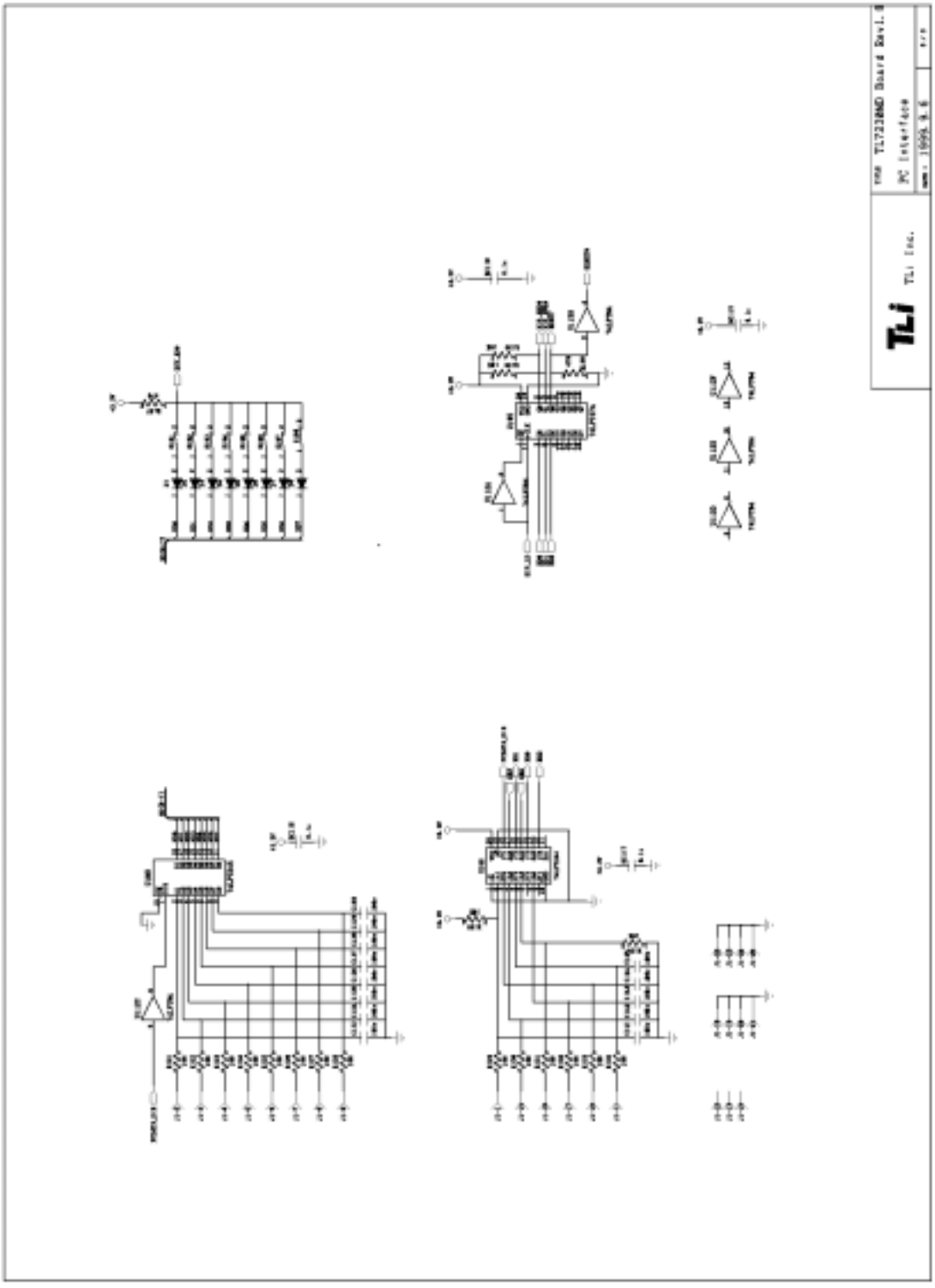

Figure 6. TL7230MD Reference Board – PC Interface