M62446AFP

6ch Electronic Volume with Tone Control

REJ03F0212-0201
Rev.2.01
Mar 31, 2008

Description

The M62446AFP is 6ch electronic volume with tone control. This IC is revised from M62446FP. The extended function of M62446AFP is volume level and tone control level. M62446AFP is easy to use more than M62446FP.

Features

- 6ch Electric volume
  Volume level: 0 to –95 dB (1 dB/step)* <M62446FP: 0 to –79 dB (1 dB/step)>
- Tone control
  Bass/Treble: –14 dB to +14 dB (2 dB/step)* <M62446FP: –10 dB to +10 dB (2 dB/step)>
- Noise voltage: 1.5 μVrms <M62446FP: 2.2 μVrms>
- 4 Output ports
- Bypass mode is high quality sound.

Note: * is an extended function.

Application

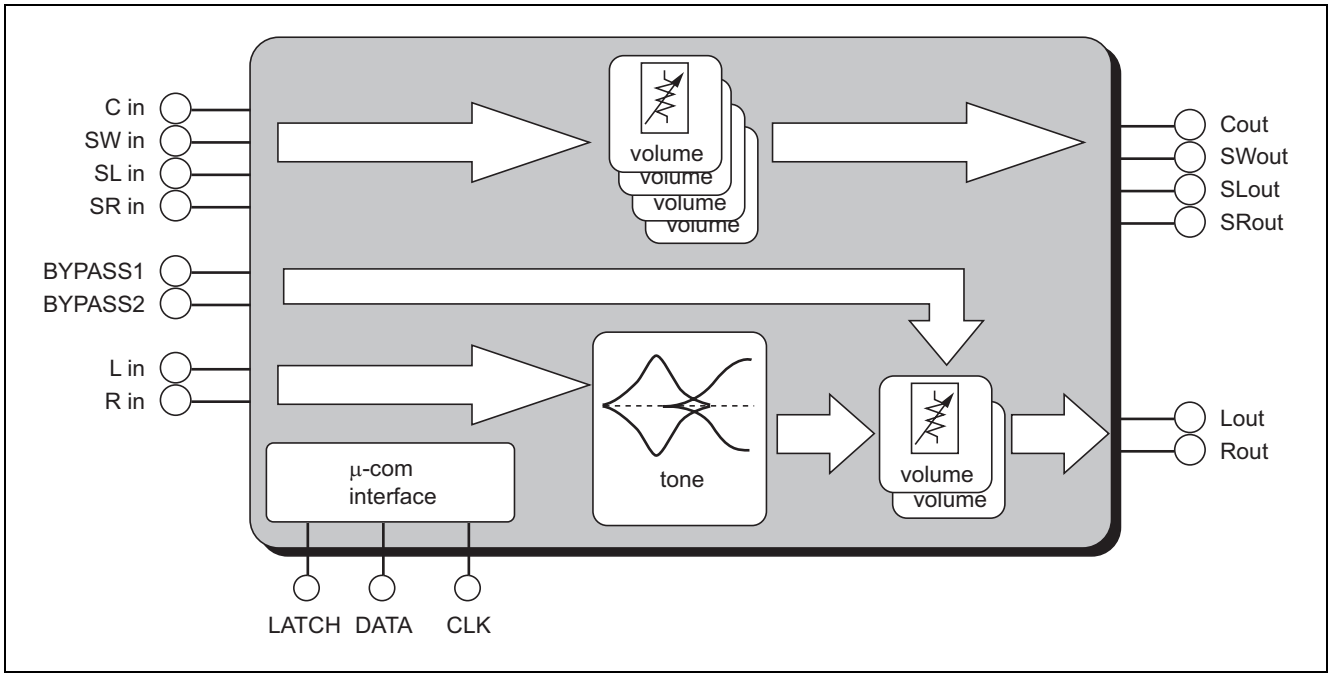
DVD, Home Audio equipment, TV

Recommended Operating Conditions

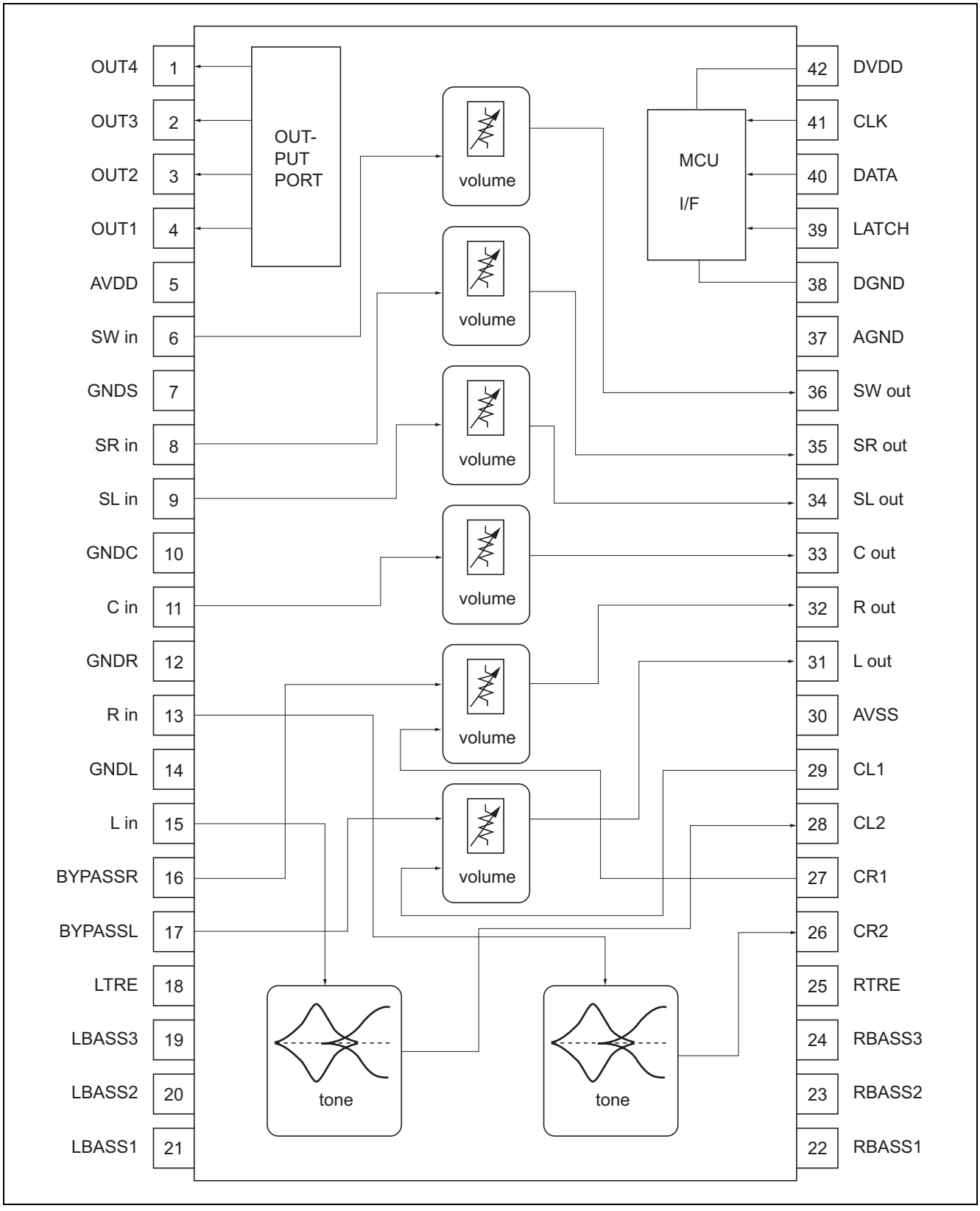
Supply voltage range: ±4.5 to ±7.5 V (analog), 4.5 V to 5.5 V (digital)

Recommended supply voltage: ±7.0 V (analog), 5.0 V (digital)

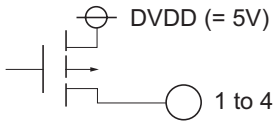
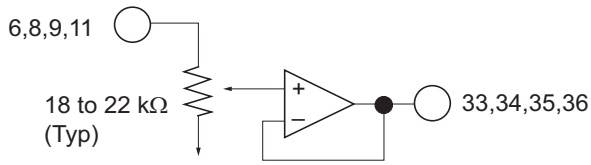
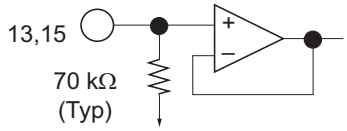
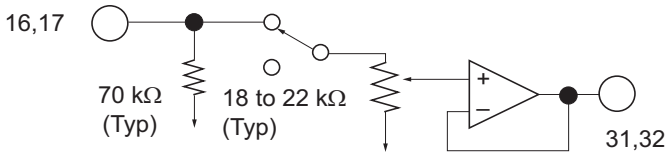
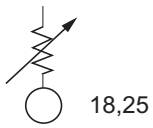
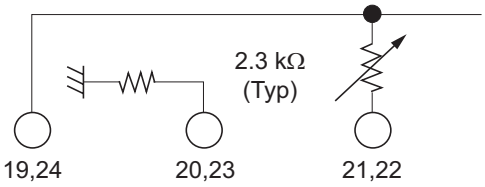
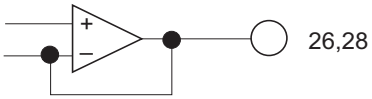
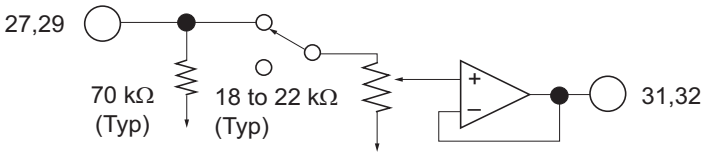
System Block Diagram

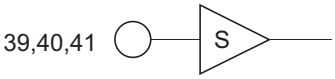


Pin Configuration and Block Diagram



Pin Description

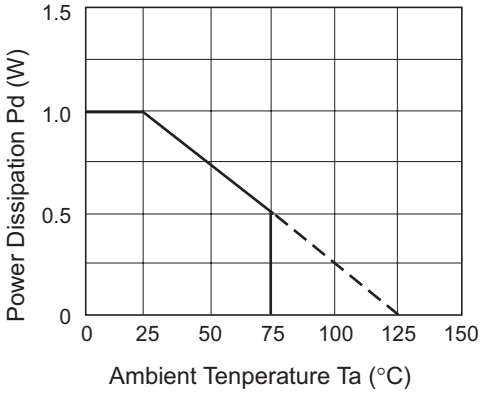
Pin No.	Symbol	Function	Circuit
1	OUT4	Port OUTPUT	OUTPUT: PMOS Transistor open drain 
2	OUT3		
3	OUT2		
4	OUT1		
5	AVDD	Analog positive power supply	+7 V
7	GNDS	GND	Connect to analog GND
10	GNDC		
12	GNDR		
14	GNDL		
6	SW in	Volume INPUT	
8	SR in		
9	SL in		
11	C in		
36	SW out	Volume OUTPUT	
35	SR out		
34	SL out		
33	C out		
13	R in	Tone INPUT	
15	L in		
16	BYPASSR	L, R volume INPUT in BYPASS mode	
17	BYPASSL		
31	L out	L OUTPUT	
32	R out	R OUTPUT	
18	LTRE	Tone treble cycle control	
25	RTRE		
19	LBASS3	Tone bass cycle control	
24	RBASS3		
20	LBASS2		
23	RBASS2		
21	LBASS1		
26	RBASS1		
22	CR2	Tone OUTPUT	
28	CL2		
27	CR1	L, R volume INPUT	
29	CL1		
31	L out	L OUTPUT	
32	R out	R OUTPUT	

Pin No.	Symbol	Function	Circuit
30	AVSS	Analog negative power supply	–7 V
37	AGND	Analog GND	
38	DGND	Digital GND	
39	LATCH	Latch INPUT	 INPUT: schmitt trigger type
40	DATA	Data INPUT	
41	CLK	Clock INPUT forward data	
42	DVDD	Digital power supply	+5 V

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Condition
Supply voltage	Vsupply	16	V	AVDD – AVSS
		7		DVDD – DGND
Power dissipation	Pd	1000	mW	Ta ≤ 25 °C
Thermal derating	Kθ	10	mW/°C	Ta > 25 °C
Operating temperature	Topr	–20 to +75	°C	
Storage temperature	Tstg	–40 to +125	°C	

Thermal Derating (Maximum Rating)
(with the standard board)



*Standard board
- board size 70 mm × 70 mm
- board thickness 1.6 mm
- board material glass epoxy
- copper pattern
  copper thickness 18 μm
  copper size 0.25 mm (wide) 30 mm (length/lead)

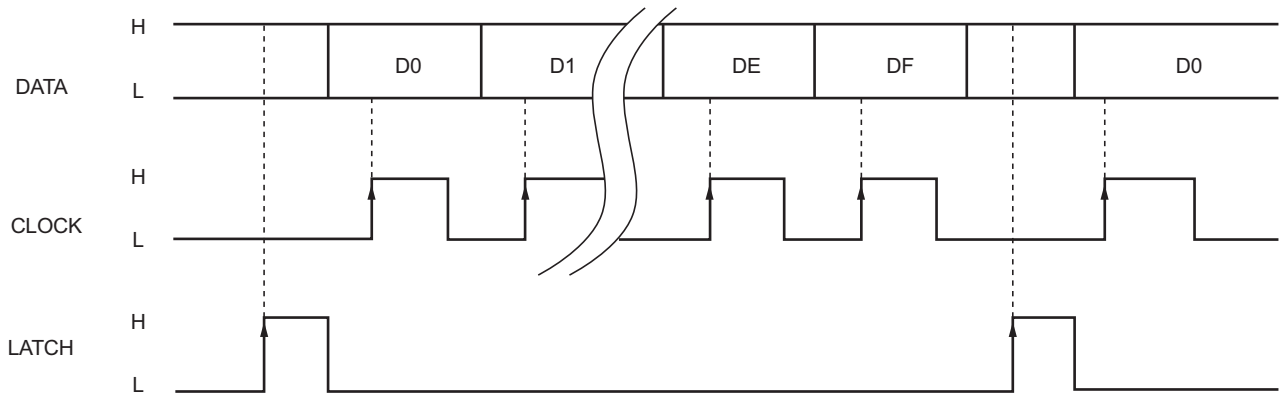
Recommended Operating Condition

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Min	Typ	Max	Unit	Condition
Analog positive supply voltage	AVDD	4.5	7.0	7.5	V	
Analog negative supply voltage	AVSS	–7.5	–7.0	–4.5	V	
Digital supply voltage	DVDD	4.5	5.0	5.5	V	
High-level input voltage	VIH	DVDD × 0.7	—	DVDD	V	
Low-level input voltage	VIL	DGND	—	DVDD × 0.3	V	

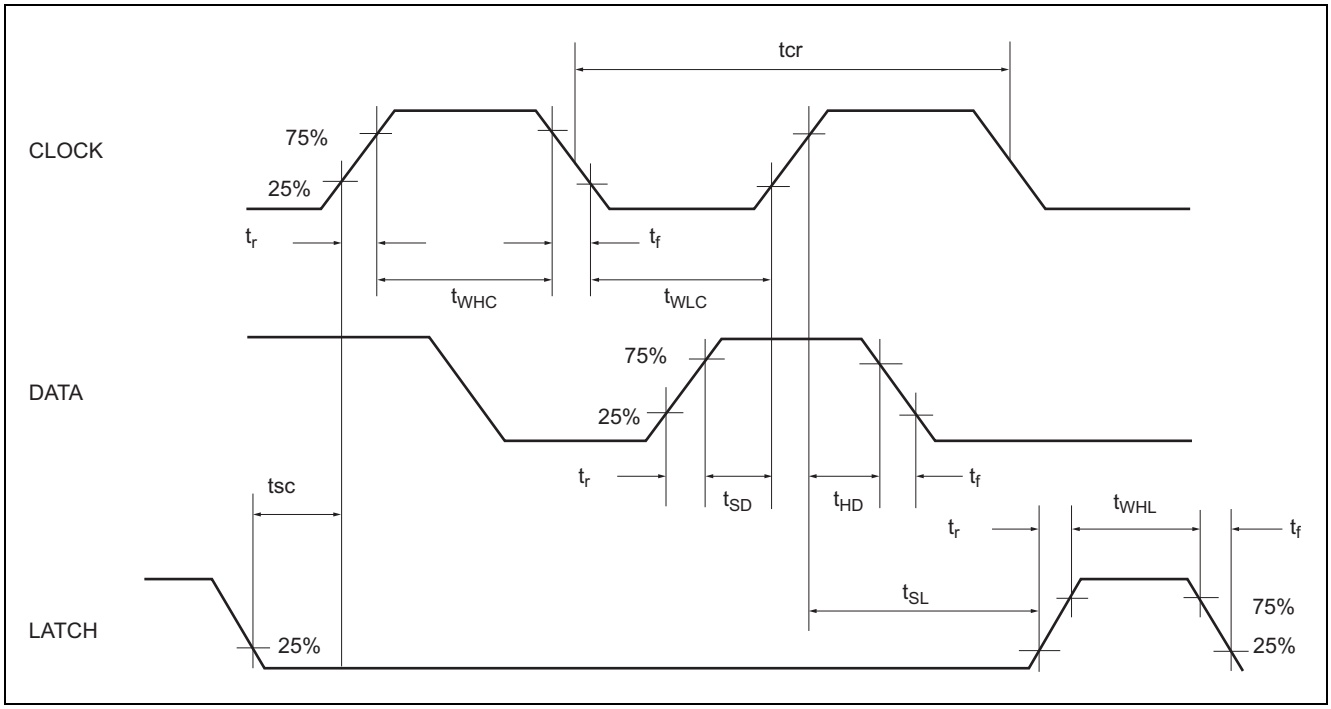
Note: AVSS ≤ DGND < DVDD ≤ AVDD

Relationship between Data and Clock and Latch



Note: CLOCK and LATCH function at raising edges of pulse.

Data Timing (Recommended Conditions)



Digital Block Timing Regulation

Item	Symbol	Limits			Unit
		Min	Typ	Max	
CLOCK cycle time	t_{cr}	8	—	—	µs
CLOCK pulse width ("H" level)	t_{WHC}	3.2	—	—	
CLOCK pulse width ("L" level)	t_{WLC}	3.2	—	—	
CLOCK, DATA, LATCH rise time	t_r	—	—	0.8	
CLOCK, DATA, LATCH fall time	t_f	—	—	0.8	
DATA setup time	t_{SD}	1.6	—	—	
DATA hold time	t_{HD}	1.6	—	—	
LATCH setup time	t_{SL}	2	—	—	
LATCH pulse width	t_{WHL}	3.2	—	—	
CLOCK start time after LATCH	t_{SC}	3.2	—	—	

Digital Control Specification

Fore kinds of input format options are available by changing slot settings of DE and DF. (When the IC is powered up, the internal settings are not fixed.)

(1)

D01	D11	D21	D31	D41	D51	D61	D71	D81	D91	DA1	DB1	DC1	DD1	DE	DF
TONE CONT TLEBLE				1	2	3	4	TONE CONT BASS				0	TONE : 0 BYPASS : 1	0	0
				OUTPUT PORT n CONT High: 1,Low: 0											

(2)

D02	D12	D22	D32	D42	D52	D62	D72	D82	D92	DA2	DB2	DC2	DD2	DE	DF
VOLUME Lch							VOLUME Rch							0	1

(3)

D03	D13	D23	D33	D43	D53	D63	D73	D83	D93	DA3	DB3	DC3	DD3	DE	DF
VOLUME Cch							VOLUME SWch							1	0

(4)

D04	D14	D24	D34	D44	D54	D64	D74	D84	D94	DA4	DB4	DC4	DD4	DE	DF
VOLUME SLch							VOLUME SRch							1	1

Setting Code

(1) Tone Control (Bass/Treble)

ATT	Treble / Bass	D01 / D81	D11 / D91	D21 / DA1	D31 / DB1
* –14 dB		1	1	1	1
* –12 dB		1	1	0	1
–10 dB		1	1	1	0
–8 dB		1	1	0	0
–6 dB		1	0	1	1
–4 dB		1	0	1	0
–2 dB		1	0	0	1
+0 dB		0	0	0	0
+2 dB		0	0	0	1
+4 dB		0	0	1	0
+6 dB		0	0	1	1
+8 dB		0	1	0	0
+10 dB		0	1	1	0
* +12 dB		0	1	0	1
* +14 dB		0	1	1	1

Note: * is an extended function.

(2) Port Output

D41 D51 D61 D71	
Out: H	1
Out: L	0

(3) Bypass Control

DD1	
BYPASS	1
TONE	0

Note: Do not input other data than the above.

(4)-1 Volume (0 to –39 dB)

ATT	Volume	D0X	D1X	D2X	D3X	D4X	D5X	D6X
		D7X	D8X	D9X	DAX	DBX	DCX	DDX
0 dB		0	0	0	0	0	0	0
–1 dB		0	0	0	0	0	0	1
–2 dB		0	0	0	0	0	1	0
–3 dB		0	0	0	0	0	1	1
–4 dB		0	0	0	0	1	0	0
–5 dB		0	0	0	0	1	0	1
–6 dB		0	0	0	0	1	1	0
–7 dB		0	0	0	0	1	1	1
–8 dB		0	0	0	1	0	0	0
–9 dB		0	0	0	1	0	0	1
–10 dB		0	0	0	1	0	1	0
–11 dB		0	0	0	1	0	1	1
–12 dB		0	0	0	1	1	0	0
–13 dB		0	0	0	1	1	0	1
–14 dB		0	0	0	1	1	1	0
–15 dB		0	0	0	1	1	1	1
–16 dB		0	0	1	0	0	0	0
–17 dB		0	0	1	0	0	0	1
–18 dB		0	0	1	0	0	1	0
–19 dB		0	0	1	0	0	1	1
–20 dB		0	0	1	0	1	0	0
–21 dB		0	0	1	0	1	0	1
–22 dB		0	0	1	0	1	1	0
–23 dB		0	0	1	0	1	1	1
–24 dB		0	0	1	1	0	0	0
–25 dB		0	0	1	1	0	0	1
–26 dB		0	0	1	1	0	1	0
–27 dB		0	0	1	1	0	1	1
–28 dB		0	0	1	1	1	0	0
–29 dB		0	0	1	1	1	0	1
–30 dB		0	0	1	1	1	1	0
–31 dB		0	0	1	1	1	1	1
–32 dB		0	1	0	0	0	0	0
–33 dB		0	1	0	0	0	0	1
–34 dB		0	1	0	0	0	1	0
–35 dB		0	1	0	0	0	1	1
–36 dB		0	1	0	0	1	0	0
–37 dB		0	1	0	0	1	0	1
–38 dB		0	1	0	0	1	1	0
–39 dB		0	1	0	0	1	1	1

Note: Do not input other data than the above.

(4)-2 Volume (–40 to –∞ dB)

ATT	Volume	D0X	D1X	D2X	D3X	D4X	D5X	D6X
		D7X	D8X	D9X	DAX	DBX	DCX	DDX
–40 dB		0	1	0	1	0	0	0
–41 dB		0	1	0	1	0	0	1
–42 dB		0	1	0	1	0	1	0
–43 dB		0	1	0	1	0	1	1
–44 dB		0	1	0	1	1	0	0
–45 dB		0	1	0	1	1	0	1
–46 dB		0	1	0	1	1	1	0
–47 dB		0	1	0	1	1	1	1
–48 dB		0	1	1	0	0	0	0
–49 dB		0	1	1	0	0	0	1
–50 dB		0	1	1	0	0	1	0
–51 dB		0	1	1	0	0	1	1
–52 dB		0	1	1	0	1	0	0
–53 dB		0	1	1	0	1	0	1
–54 dB		0	1	1	0	1	1	0
–55 dB		0	1	1	0	1	1	1
–56 dB		0	1	1	1	0	0	0
–57 dB		0	1	1	1	0	0	1
–58 dB		0	1	1	1	0	1	0
–59 dB		0	1	1	1	0	1	1
–60 dB		0	1	1	1	1	0	0
–61 dB		0	1	1	1	1	0	1
–62 dB		0	1	1	1	1	1	0
–63 dB		0	1	1	1	1	1	1
–64 dB		1	0	0	0	0	0	0
–65 dB		1	0	0	0	0	0	1
–66 dB		1	0	0	0	0	1	0
–67 dB		1	0	0	0	0	1	1
–68 dB		1	0	0	0	1	0	0
–69 dB		1	0	0	0	1	0	1
–70 dB		1	0	0	0	1	1	0
–71 dB		1	0	0	0	1	1	1
–72 dB		1	0	0	1	0	0	0
–73 dB		1	0	0	1	0	0	1
–74 dB		1	0	0	1	0	1	0
–75 dB		1	0	0	1	0	1	1
–76 dB		1	0	0	1	1	0	0
–77 dB		1	0	0	1	1	0	1
–78 dB		1	0	0	1	1	1	0
–79 dB		1	0	0	1	1	1	1
–∞ dB		1	0	1	0	0	0	0

Note: Do not input other data than the above.

(4)-3 VOLUME (–80 to –∞ dB)

This is an extended function from M62446FP.

ATT / Volume	D0X / D7X	D1X / D8X	D2X / D9X	D3X / DAX	D4X / DBX	D5X / DCX	D6X / DDX
–∞ dB	1	0	1	0	0	0	1
–∞ dB	1	0	1	0	0	1	0
–∞ dB	1	0	1	0	0	1	1
↓							
↓							
–∞ dB	1	0	1	1	1	1	0
–∞ dB	1	0	1	1	1	1	1
–80 dB	1	1	0	0	0	0	0
–81 dB	1	1	0	0	0	0	1
–82 dB	1	1	0	0	0	1	0
–83 dB	1	1	0	0	0	1	1
–84 dB	1	1	0	0	1	0	0
–85 dB	1	1	0	0	1	0	1
–86 dB	1	1	0	0	1	1	0
–87 dB	1	1	0	0	1	1	1
–88 dB	1	1	0	1	0	0	0
–89 dB	1	1	0	1	0	0	1
–90 dB	1	1	0	1	0	1	0
–91 dB	1	1	0	1	0	1	1
–92 dB	1	1	0	1	1	0	0
–93 dB	1	1	0	1	1	0	1
–94 dB	1	1	0	1	1	1	0
–95 dB	1	1	0	1	1	1	1
–∞ dB	1	1	1	0	0	0	0
–∞ dB	1	1	1	0	0	0	1
↓							
↓							
–∞ dB	1	1	1	1	1	1	0
–∞ dB	1	1	1	1	1	1	1

Electrical Characteristics

(Ta = 25°C, AVDD/AVSS/DVDD = 7/–7 V/5 V, f = 1 kHz, unless otherwise noted.
Rg = 1 kΩ, RL = 10 kΩ, TONE CONTROL • VOL are set to 0 dB/FLAT.)

(1) Power Supply Characteristics

Item	Symbol	Limits			Unit	Test Condition
		Min	Typ	Max		
Analog positive circuit current	Aldd	—	22	35	mA	Current at pin 5 No signal
Analog negative circuit current	Alss	—	22	35	mA	Current at pin 30 No signal
Digital circuit current	Dldd	—	1.0	2.0	mA	Current at pin 42 No signal

(2) Input/Output Characteristics

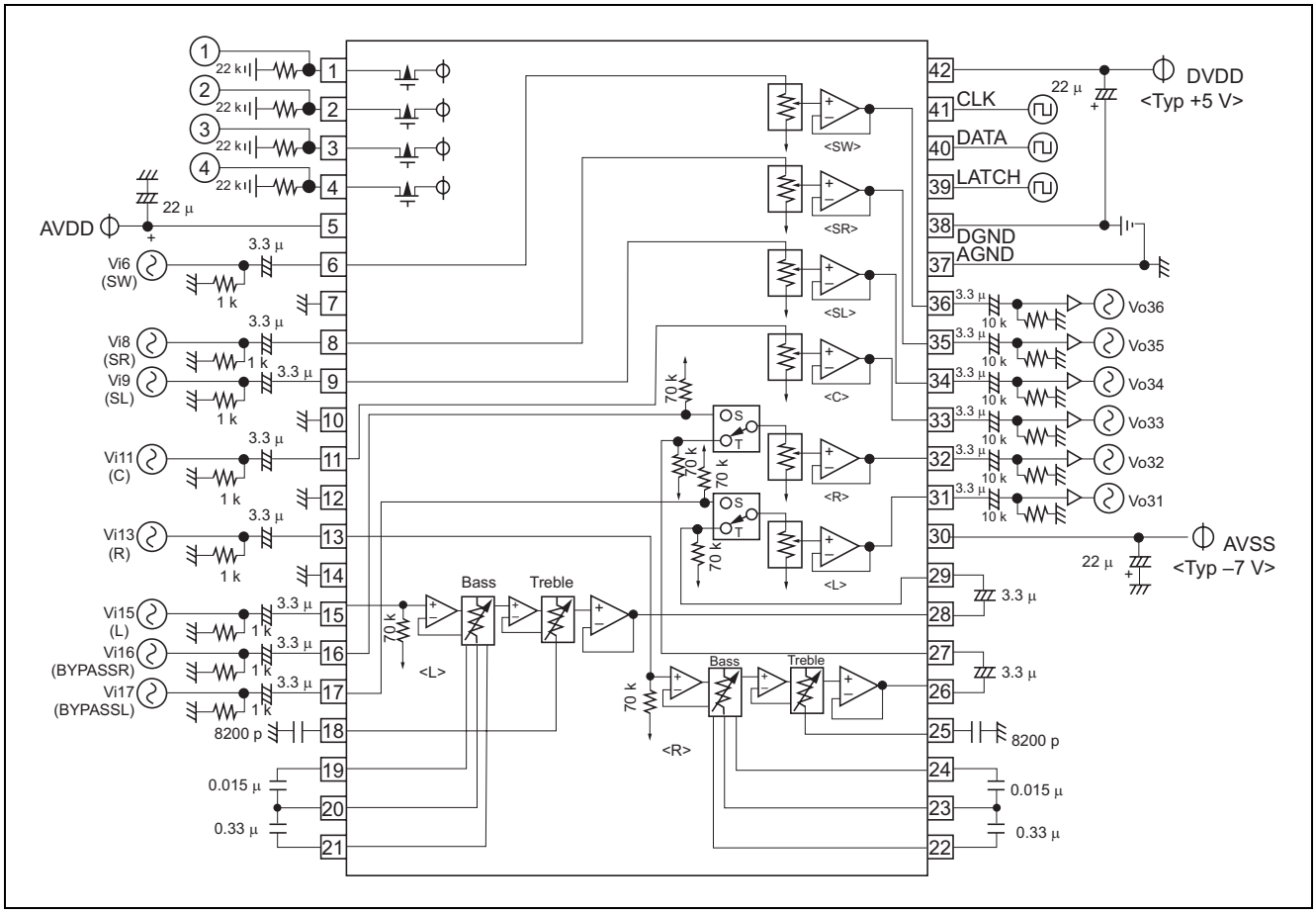
Item	Symbol	Limits			Unit	Test Condition
		Min	Typ	Max		
Input resistance	Ri	35	70	150	kΩ	13, 15, 16, 17, 27, 29 pin
Maximum output voltage	VOM	3.0	4.2	—	Vrms	6, 8, 9, 11, 13, 15, 16, 17 pin INPUT 31 to 36 pin OUTPUT THD = 1%
Pass gain	Gv	–2.0	0	2.0	dB	Vi = 0.2 Vrms, FLAT 8, 9, 11, 13, 15, 16, 17 pin INPUT 31 to 36 pin OUTPUT
Distortion	THD	—	0.002	0.09	%	BW = 400 to 30 kHz Vi = 0.2 Vrms, RL = 10 kΩ
Output noise voltage	Vn (VOL)	—	1.5	6	μVrms	31 to 36 pin, Rg = 0 kΩ, JIS-A, VOL = 0 dB
	Vn (tone)	—	5	20	μVrms	31, 32 pin JIS-A, VOL = 0 dB
Maximum attenuation	ATTmax	—	–100	–95	dB	31 to 36 pin JIS-A, VOL = –∞ dB
Volume gain between channels	Dvol	–1.5	0	1.5	dB	
Crosstalk between channels	CT	—	–80	–65	dB	Vo = 0.5 Vrms, RL = 10 kΩ, JIS-A, Rg = 1 kΩ
Port output current	IL	0.2	—	—	mA	

(3) Tone Control Characteristics

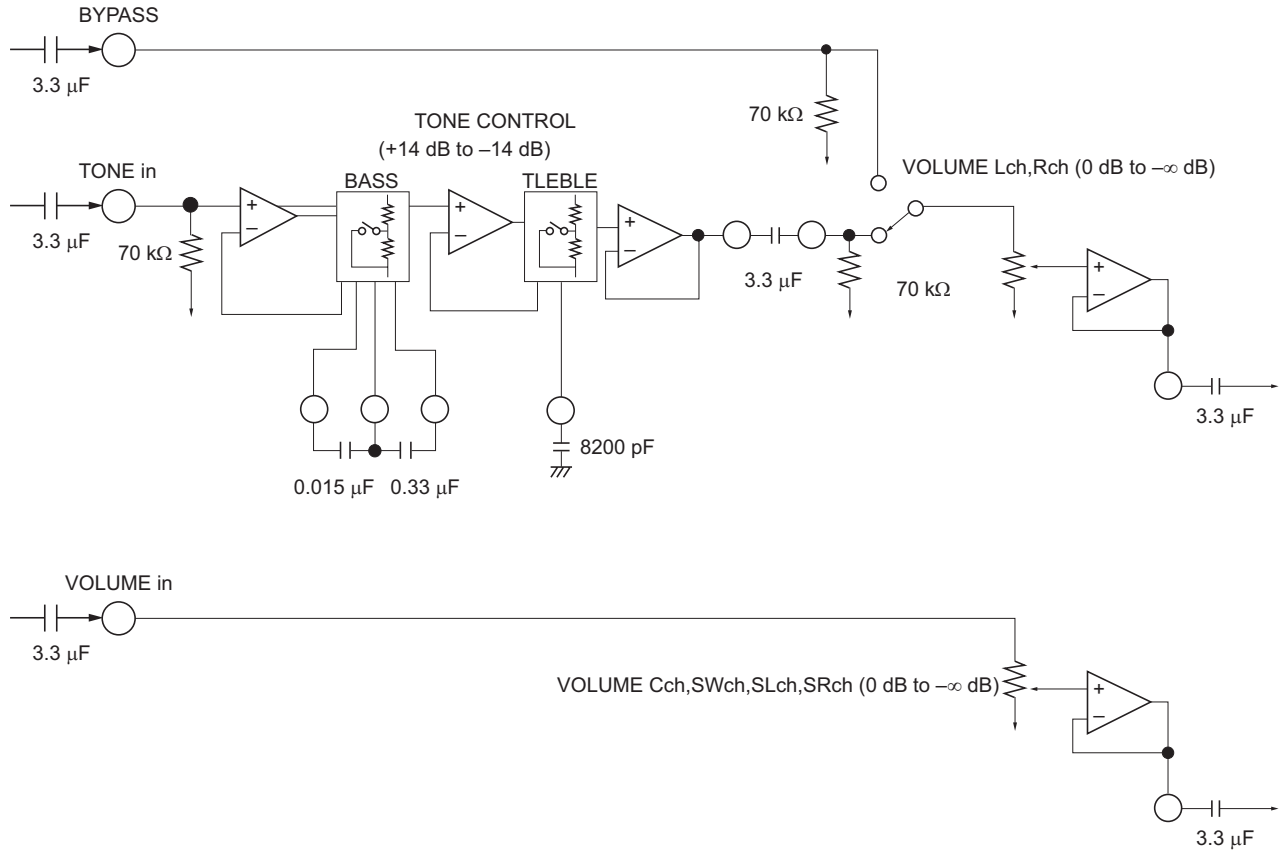
Item	Symbol	Limits			Unit	Test Condition
		Min	Typ	Max		
Tone control voltage gain	*T +14 dB	12	14	16	dB	Vo = 0.2 Vrms, TREBLE (f = 10 kHz), BASS (f = 100 Hz), Voltage gain (Input to pin 13, 15 Output from pin 31, 32) INPUT 13, 15 pin OUTPUT 31, 32 pin
	*T +12 dB	10	12	14	dB	
	T +10 dB	8	10	12	dB	
	T +8 dB	6	8	10	dB	
	T +6 dB	4.5	6	7.5	dB	
	T +4 dB	2.5	4	5.5	dB	
	T +2 dB	1	2	3	dB	
	T –2 dB	–3	–2	–1	dB	
	T –4 dB	–5.5	–4	–2.5	dB	
	T –6 dB	–7.5	–6	–4.5	dB	
	T –8 dB	–10	–8	–6	dB	
	T –10 dB	–12	–10	–8	dB	
	*T –12 dB	–14	–12	–10	dB	
	*T –14 dB	–16	–14	–12	dB	
Balance between channel	BALT	–1.5	0	+1.5	dB	Input 13, 15 pin Vo = 0.2 Vrms Output 31, 32 pin

Note: * is an extended function.

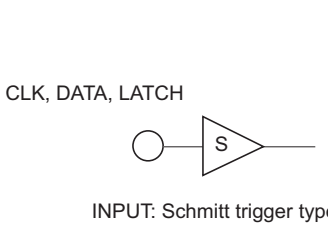
Test Circuit

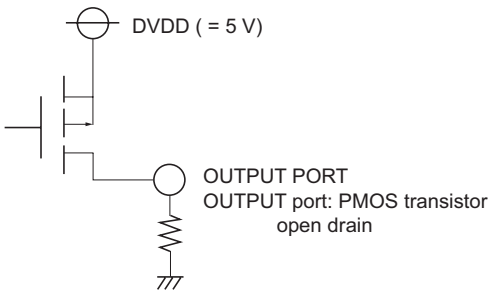


Signal Processing Diagram



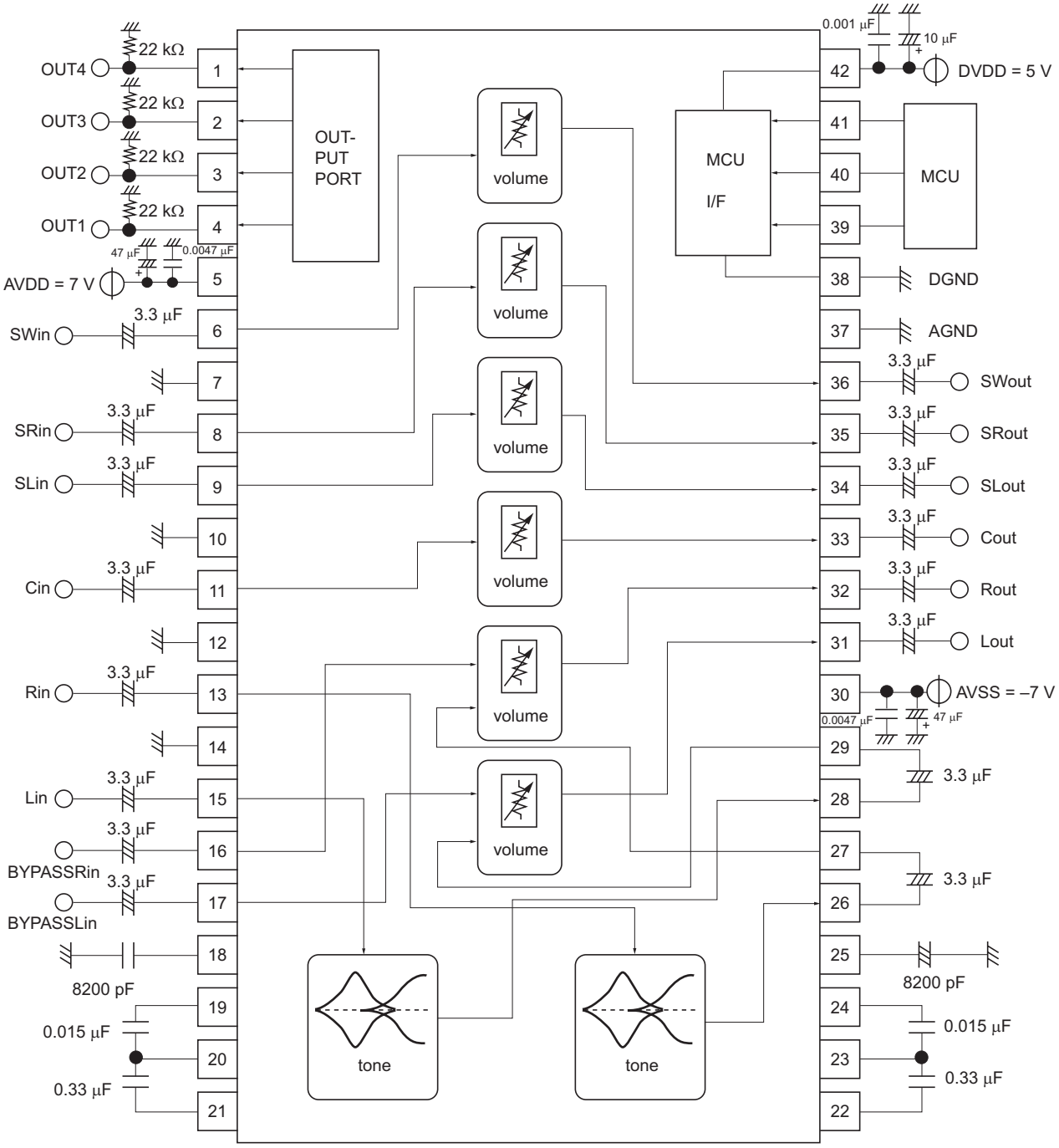
Notes:
1. The resistance value of Volume change about 18 to 22 kΩ by attenuated condition.
2. No built a zero cross circuit.
3. When the mode changed (BYPASS/TONE), it is necessary the muting function.





Application Example

When using Tone control and Bypass

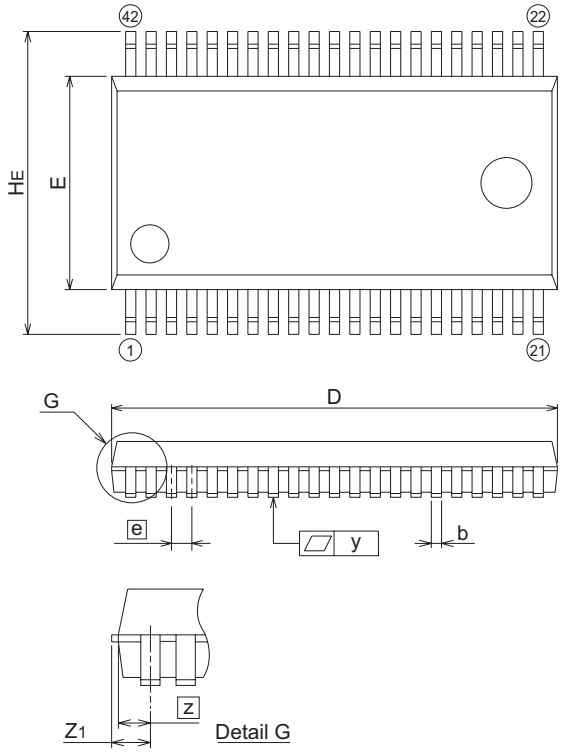


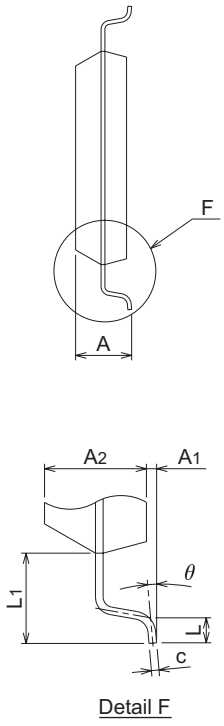
Package Dimensions

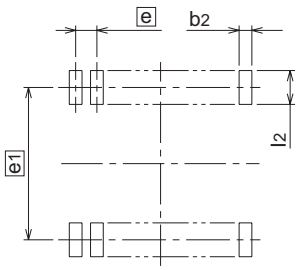
42P2R-A (MMP)

Plastic 42pin 450mil SSOP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP42-P-450-0.80	—	0.63	Alloy 42/Cu Alloy







Recommended Mount Pad

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	2.4
A_1	0.05	—	—
A_2	—	2.0	—
b	0.35	0.4	0.5
c	0.13	0.15	0.2
D	17.3	17.5	17.7
E	8.2	8.4	8.6
e	—	0.8	—
H_E	11.63	11.93	12.23
L	0.3	0.5	0.7
L_1	—	1.765	—
z	—	0.75	—
Z_1	—	—	0.9
y	—	—	0.15
θ	0°	—	10°
b_2	—	0.5	—
e_1	—	11.43	—
l_2	1.27	—	—

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Colophon .7.2