CPU AGB A, CPU AGB B, CPU AGB E

Arm®-based 32-bit MCU+PPU, 16.78 MHz, 16 KB ROM, 386 KB RAM

Datasheet

1 Features

- Arm®-based 32-bit ARM7TDMI MCU
- Power supplies
  - 3.3V main supply voltage
  - 2.5V (CPU AGB A/B only)
  - 1.8V core voltage (CPU AGB B/E only)
- Memories
  - 16 KB BIOS ROM providing arithmetic, rotation/scaling, decompression, memory copy, sound and other functions
  - 32 KB internal work RAM
  - 256 KB external work RAM
  - 96 KB video RAM
  - 1 KB object attribute memory
  - 1 KB palette RAM
- 16-bit Game Pak memory interface, 24-bit address, 8 x 16-bit prefetch buffer
- 15-bit TFT LCD interface, RGB 555, 240 x 160 pixels, 60 Hz
- Picture Processing Unit (PPU)
  - 128 objects (up to 64 x 64 pixels)
  - 4 backgrounds (up to 1024 x 1024 pixels)
  - Bitmap mode (240 x 160 or 160 x 128 pixels)
- Sound
  - 2 DMA sound channels
  - 4 channel Audio Processing Unit (APU)
- Serial communication interface
  - Normal mode
  - Multi-Player mode
  - UART mode
  - JOY BUS mode
  - General-Purpose mode
- 4 16-bit timers
  - All mappable as interrupt source
  - Multiple timers can be linked
- 4 channel DMA controller
- 10 keypad inputs
  - All mappable as interrupt source

2 Description

The CPU AGB A/B/E devices are based on the Arm® ARM7TDMI 32-bit core operating at a frequency of 16.777 MHz. They also contain a Z80/8080 based 8-bit core operating at a frequency of 4.194 MHz or 8.388 MHz which can execute software developed for DMG/CGB devices.

These devices embed high-speed memories (32 KB internal work RAM, 256 KB external work RAM and a total of 98 KB of video RAM) as well as a 16 KB BIOS ROM which provides arithmetic, rotation/scaling, decompression, memory copy, sound and other functions. Program instructions and data are fetched via the 16-bit Game Pak memory interface which also features a prefetch buffer. Additionaly they integrate a range of peripherals, including an LCD interface, stereo sound output, keypad inputs, a serial communication interface, timers and a DMA controller.

The devices embed a graphics accelerator (Picture Processing Unit) which can operate in 6 different modes. It features 4 independent background layers as well as an object layer. It also provides hardware scrolling, scaling, rotating, windowing, mosaic and alpha blending effects.

3 Device Information

Table 1: Device information

Part Number	Package	Package Size
CPU AGB A	QFP-128	14mm x 20mm
CPU AGB B	QFP-156	14mm x 20mm
CPU AGB E	CSP-BGA-160	12mm x 12mm

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4 Introduction

This document provides information on CPU AGB A/B/E microcontrollers, such as description, functional overview, pin assignment and definition, electrical characteristics and packaging.

This document should be read in conjunction with the AGB programming manual, available on www. archive.org.

For information on the Arm® ARM7TDMI core, refer to the ARM7TDMI technical reference manual, available from the www.arm.com website.

5 Pinouts and Pin Description

5.1 QFP-128 Pinout Description

Figure 1: CPU AGB A QFP-128 pinout
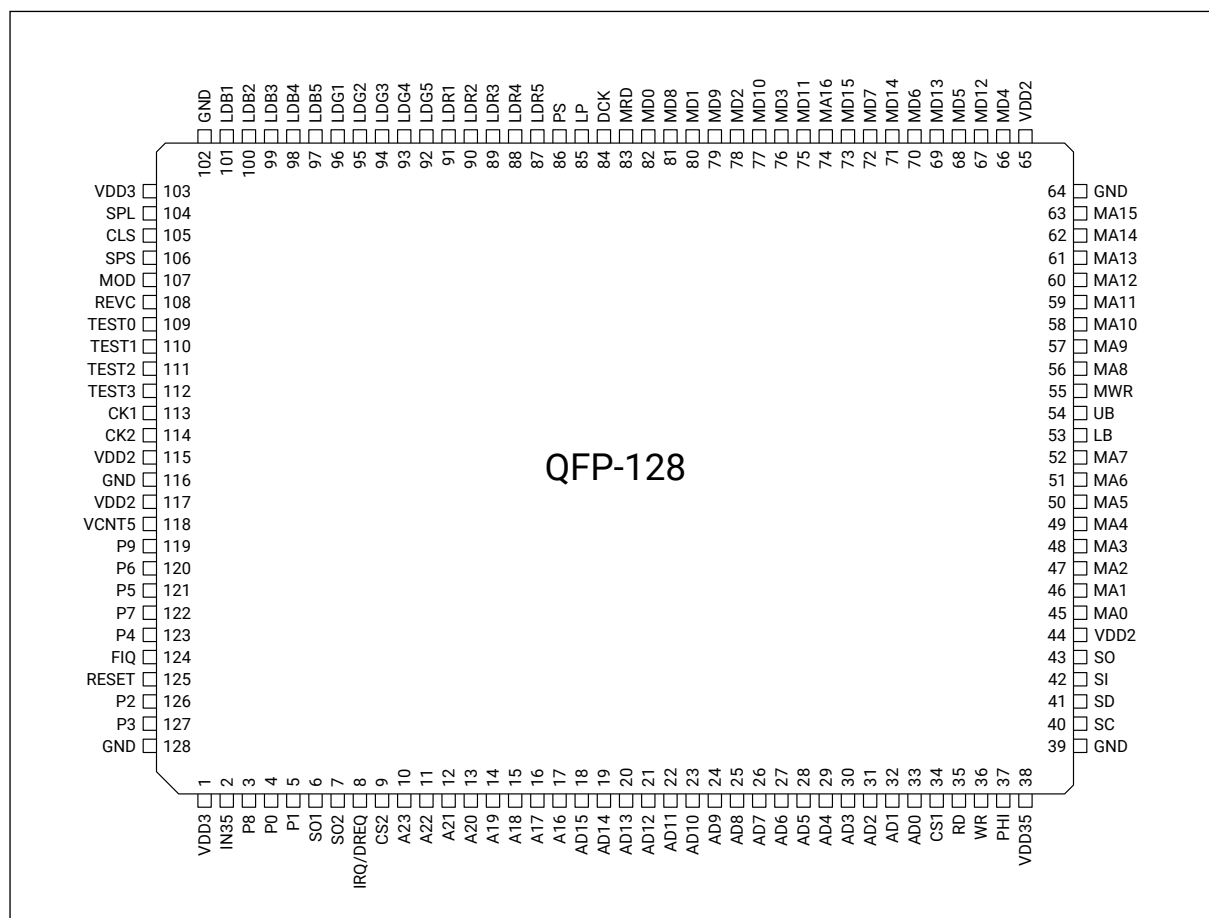
5.2 QFP-156 Pinout Description

Figure 2: CPU AGB B QFP-156 pinout

5.3 CSP-BGA-160 Pinout Description

Figure 3: CPU AGB E CSP-BGA-160 pinout

5.4 Pin/Ball Definition

Table 2: CPU AGB A/B/E pin definition

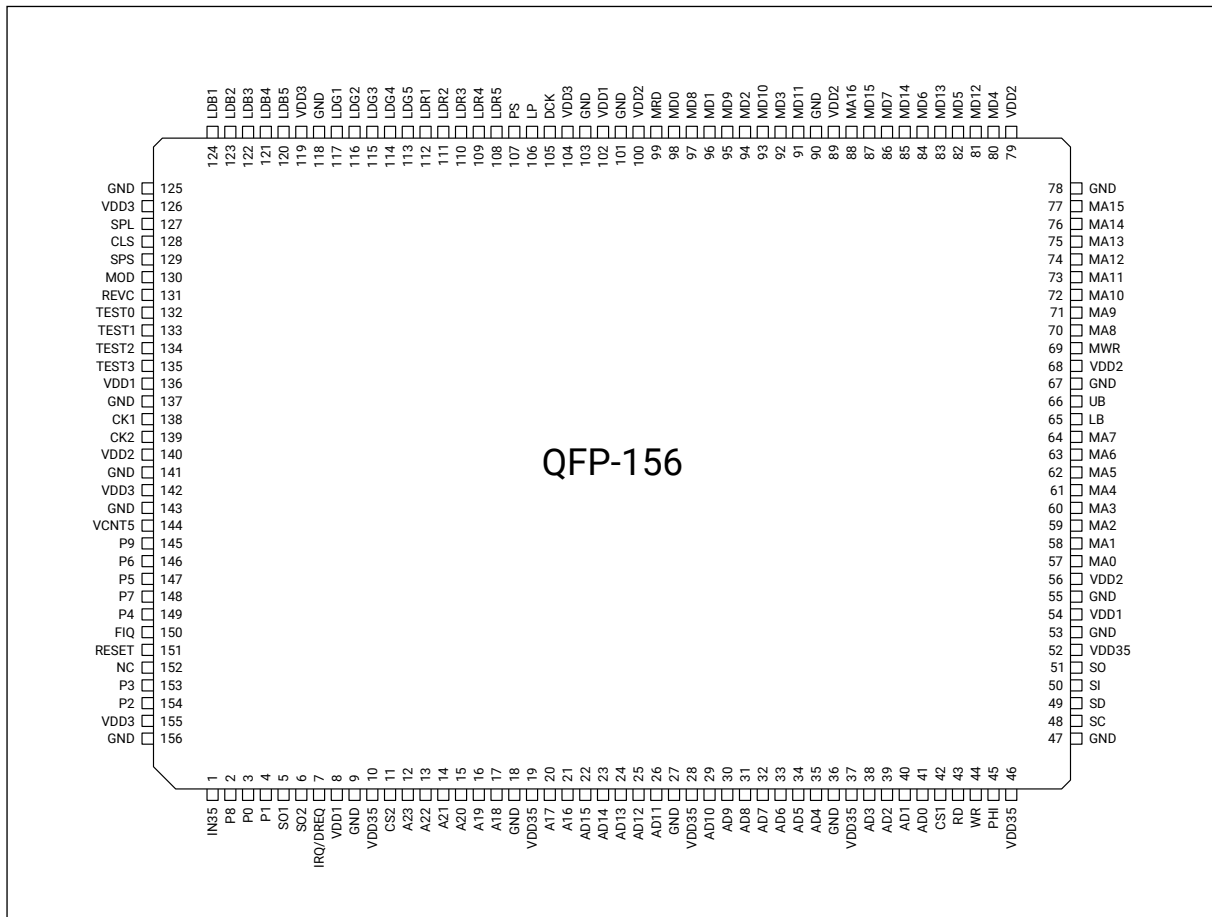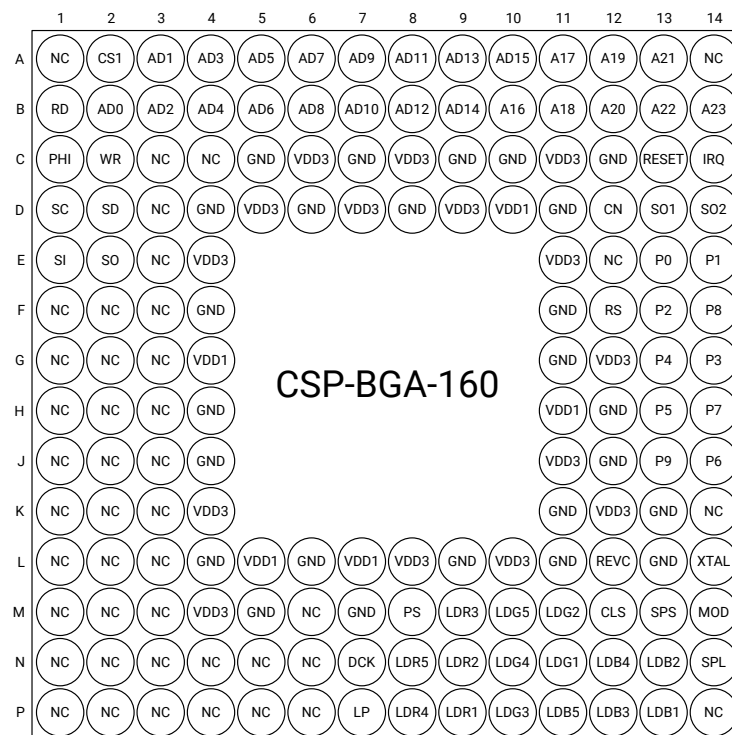| QFP-128	QFP-156	CSP-BGA-160	Pin Name	Pin Type	Description
1	-	C6	VDD3	Supply	3.3V Power supply
2	1	-	IN35	Input	Cartridge voltage switch feedback
3	2	F14	P8	Input	Keypad button "Shoulder R"
4	3	E13	P0	Input	Keypad button "A"
5	4	E14	P1	Input	Keypad button "B"
6	5	D13	SO1	Output	Sound output right
7	6	D14	SO2	Output	Sound output left
8	7	C14	$\overline{\text{IRQ}}/\overline{\text{DREQ}}$	Input	Cartridge interrupt/DMA request signal
-	8	D10	VDD1	Supply	1.8V Power supply
-	9	C5	GND	Supply	Ground reference
-	10	-	VDD35	Supply	3.3V or 5V Power supply
9	11	-	$\overline{\text{CS2}}$	Output	Cartridge chip select 2
10	12	B14	A23	Output	Cartridge address, bit 23
11	13	B13	A22	Output	Cartridge address, bit 22
12	14	A13	A21	Output	Cartridge address, bit 21
13	15	B12	A20	Output	Cartridge address, bit 20
14	16	A12	A19	Output	Cartridge address, bit 19
15	17	B11	A18	Output	Cartridge address, bit 18
-	18	C7	GND	Supply	Ground reference
-	19	-	VDD35	Supply	3.3V or 5V Power supply
16	20	A11	A17	Output	Cartridge address, bit 17
17	21	B10	A16	Output	Cartridge address, bit 16
18	22	A10	AD15	I/O	Cartridge address/data, bit 15
19	23	B9	AD14	I/O	Cartridge address/data, bit 14
20	24	A9	AD13	I/O	Cartridge address/data, bit 13
21	25	B8	AD12	I/O	Cartridge address/data, bit 12
22	26	A8	AD11	I/O	Cartridge address/data, bit 11
-	27	C9	GND	Supply	Ground reference
-	28	-	VDD35	Supply	3.3V or 5V Power supply
23	29	B7	AD10	I/O	Cartridge address/data, bit 10
24	30	A7	AD9	I/O	Cartridge address/data, bit 9
25	31	B6	AD8	I/O	Cartridge address/data, bit 8
26	32	A6	AD7	I/O	Cartridge address/data, bit 7
27	33	B5	AD6	I/O	Cartridge address/data, bit 6
28	34	A5	AD5	I/O	Cartridge address/data, bit 5

29	35	B4	AD4	I/O	Cartridge address/data, bit 4
-	36	C10	GND	Supply	Ground reference
-	37	-	VDD35	Supply	3.3V or 5V Power supply
30	38	A4	AD3	I/O	Cartridge address/data, bit 3
31	39	B3	AD2	I/O	Cartridge address/data, bit 2
32	40	A3	AD1	I/O	Cartridge address/data, bit 1
33	41	B2	AD0	I/O	Cartridge address/data, bit 0
34	42	A2	$\overline{CS1}$	Output	Cartridge chip select 1
35	43	B1	$\overline{RD}$	Output	Cartridge read signal
36	44	C2	$\overline{WR}$	Output	Cartridge write signal
37	45	C1	PHI	Output	Cartridge clock signal
38	46	-	VDD35	Supply	3.3V or 5V Power supply
39	47	C12	GND	Supply	Ground reference
40	48	D1	SC	I/O	Serial communication pin "SC"
41	49	D2	SD	I/O	Serial communication pin "SD"
42	50	E1	SI	I/O	Serial communication pin "SI"
43	51	E2	SO	I/O	Serial communication pin "SO"
-	52	-	VDD35	Supply	3.3V or 5V Power supply
-	53	D4	GND	Supply	Ground reference
-	54	G4	VDD1	Supply	1.8V Power supply
-	55	D6	GND	Supply	Ground reference
44	56	-	VDD2	Supply	2.5V Power supply
45	57	-	MA0	Output	Work RAM address, bit 0
46	58	-	MA1	Output	Work RAM address, bit 1
47	59	-	MA2	Output	Work RAM address, bit 2
48	60	-	MA3	Output	Work RAM address, bit 3
49	61	-	MA4	Output	Work RAM address, bit 4
50	62	-	MA5	Output	Work RAM address, bit 5
51	63	-	MA6	Output	Work RAM address, bit 6
52	64	-	MA7	Output	Work RAM address, bit 7
53	65	-	$\overline{LB}$	Output	Work RAM lower byte select
54	66	-	$\overline{UB}$	Output	Work RAM upper byte select
-	67	D8	GND	Supply	Ground reference
-	68	-	VDD2	Supply	2.5V Power supply
55	69	-	$\overline{MWR}$	Output	Work RAM write enable signal
56	70	-	MA8	Output	Work RAM address, bit 8
57	71	-	MA9	Output	Work RAM address, bit 9
58	72	-	MA10	Output	Work RAM address, bit 10
59	73	-	MA11	Output	Work RAM address, bit 11
60	74	-	MA12	Output	Work RAM address, bit 12
61	75	-	MA13	Output	Work RAM address, bit 13
62	76	-	MA14	Output	Work RAM address, bit 14
63	77	-	MA15	Output	Work RAM address, bit 15

64	78	D11	GND	Supply	Ground reference
65	79	-	VDD2	Supply	2.5V Power supply
66	80	-	MD4	Input	Work RAM data, bit 4
67	81	-	MD12	Input	Work RAM data, bit 12
68	82	-	MD5	Input	Work RAM data, bit 5
69	83	-	MD13	Input	Work RAM data, bit 13
70	84	-	MD6	Input	Work RAM data, bit 6
71	85	-	MD14	Input	Work RAM data, bit 14
72	86	-	MD7	Input	Work RAM data, bit 7
73	87	-	MD15	Input	Work RAM data, bit 15
74	88	-	MA16	Output	Work RAM address, bit 16
-	89	-	VDD2	Supply	2.5V Power supply
-	90	F4	GND	Supply	Ground reference
75	91	-	MD11	Input	Work RAM data, bit 11
76	92	-	MD3	Input	Work RAM data, bit 3
77	93	-	MD10	Input	Work RAM data, bit 10
78	94	-	MD2	Input	Work RAM data, bit 2
79	95	-	MD9	Input	Work RAM data, bit 9
80	96	-	MD1	Input	Work RAM data, bit 1
81	97	-	MD8	Input	Work RAM data, bit 8
82	98	-	MD0	Input	Work RAM data, bit 0
83	99	-	$\overline{\text{MRD}}$	Output	Work RAM output enable signal
-	100	-	VDD2	Supply	2.5V Power supply
-	101	F11	GND	Supply	Ground reference
-	102	H11	VDD1	Supply	1.8V Power supply
-	103	G11	GND	Supply	Ground reference
-	104	C8	VDD3	Supply	3.3V Power supply
84	105	N7	DCK	Output	Display data sampling clock signal
85	106	P7	LP	Output	Display data latch signal
86	107	M8	PS	Output	Display power save signal
87	108	N8	LDR5	Output	Display data red, bit 5
88	109	P8	LDR4	Output	Display data red, bit 4
89	110	M9	LDR3	Output	Display data red, bit 3
90	111	N9	LDR2	Output	Display data red, bit 2
91	112	P9	LDR1	Output	Display data red, bit 1
92	113	M10	LDG5	Output	Display data green, bit 5
93	114	N10	LDG4	Output	Display data green, bit 4
94	115	P10	LDG3	Output	Display data green, bit 3
95	116	M11	LDG2	Output	Display data green, bit 2
96	117	N11	LDG1	Output	Display data green, bit 1
-	118	H4	GND	Supply	Ground reference
-	119	C11	VDD3	Supply	3.3V Power supply
97	120	P11	LDB5	Output	Display data blue, bit 5

98	121	N12	LDB4	Output	Display data blue, bit 4
99	122	P12	LDB3	Output	Display data blue, bit 3
100	123	N13	LDB2	Output	Display data blue, bit 2
101	124	P13	LDB1	Output	Display data blue, bit 1
102	125	H12	GND	Supply	Ground reference
103	126	D5	VDD3	Supply	3.3V Power supply
104	127	N14	SPL	Output	Display sampling start signal
105	128	M12	CLS	Output	Display gate driver clock signal
106	129	M13	SPS	Output	Display gate driver start signal
107	130	M14	MOD	Output	Display gate driver control signal
108	131	L12	REVC	Output	Display reverse control signal
109	132	-	TEST0	Unknown	Unknown purpose
110	133	-	TEST1	Unknown	Unknown purpose
111	134	-	TEST2	Unknown	Unknown purpose
112	135	-	TEST3	Unknown	Unknown purpose
-	136	L5	VDD1	Supply	1.8V Power supply
-	137	J4	GND	Supply	Ground reference
113	138	-	CK1	-	Crystal oscillator
114	139	-	CK2	-	Crystal oscillator
-	-	L14	XTAL	-	Crystal oscillator
115	140	-	VDD2	Supply	2.5V Power supply
116	141	J12	GND	Supply	Ground reference
117	-	-	VDD2	Supply	2.5V Power supply
-	142	D7	VDD3	Supply	3.3V Power supply
-	143	K11	GND	Supply	Ground reference
118	144	-	VCNT5	Output	Display digital power supply switch
119	145	J13	P9	Input	Keypad button "Shoulder L"
120	146	J14	P6	Input	Keypad button "D-Pad Up"
121	147	H13	P5	Input	Keypad button "D-Pad Left"
122	148	H14	P7	Input	Keypad button "D-Pad Down"
123	149	G13	P4	Input	Keypad button "D-Pad Right"
124	150	-	FIQ	Unknown	Unknown purpose
125	151	C13	$\overline{\text{RESET}}$	Input	Device reset
127	153	G14	P3	Input	Keypad button "Start"
126	154	F13	P2	Input	Keypad button "Select"
-	155	D9	VDD3	Supply	3.3V Power supply
128	156	K13	GND	Supply	Ground reference
-	-	D12	CN	Unknown	Unknown purpose
-	-	F12	RS	Unknown	Unknown purpose
-	-	E4	VDD3	Supply	3.3V Power supply
-	-	E11	VDD3	Supply	3.3V Power supply
-	-	G12	VDD3	Supply	3.3V Power supply
-	-	J11	VDD3	Supply	3.3V Power supply

| -	-	K4	VDD3	Supply	3.3V Power supply
-	-	K12	VDD3	Supply	3.3V Power supply
-	-	L8	VDD3	Supply	3.3V Power supply
-	-	L10	VDD3	Supply	3.3V Power supply
-	-	M4	VDD3	Supply	3.3V Power supply
-	-	L7	VDD1	Supply	1.8V Power supply
-	-	L4	GND	Supply	Ground reference
-	-	L6	GND	Supply	Ground reference
-	-	L9	GND	Supply	Ground reference
-	-	L11	GND	Supply	Ground reference
-	-	L13	GND	Supply	Ground reference
-	-	M5	GND	Supply	Ground reference
-	-	M7	GND	Supply	Ground reference

6 Memory Map

Figure 4: Memory map
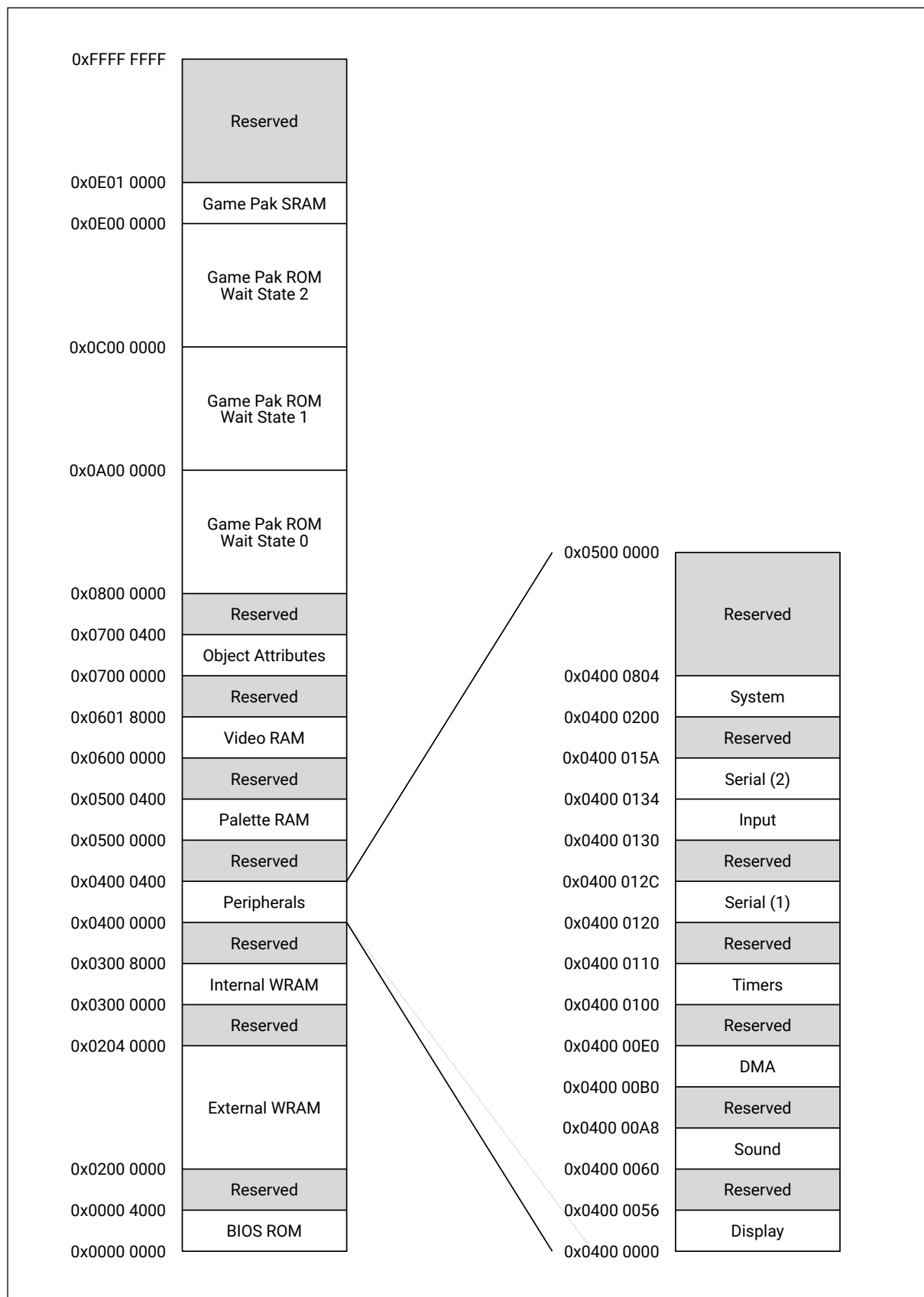
7 Package Information

7.1 QFP-128 Package Information
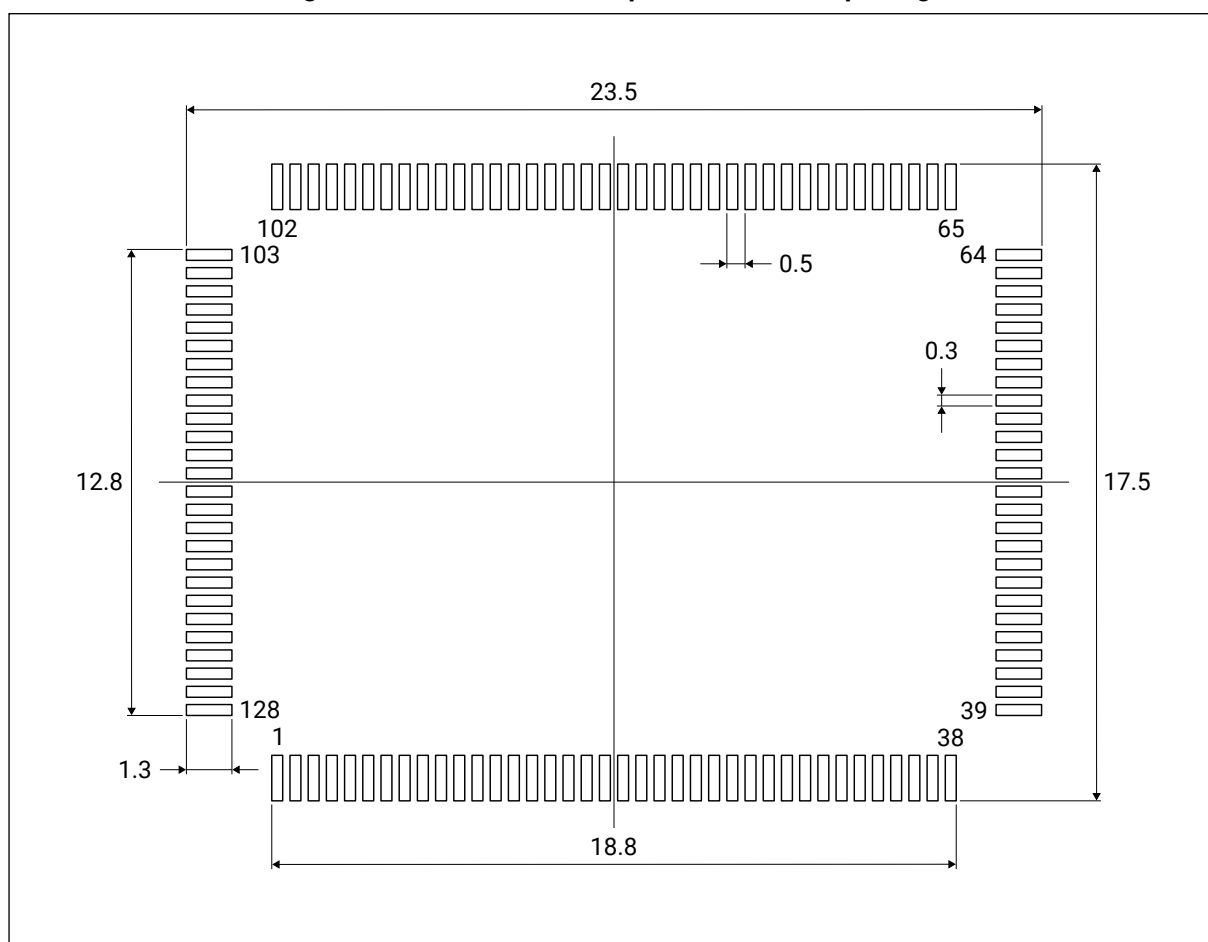
Figure 5: QFP-128 package outline
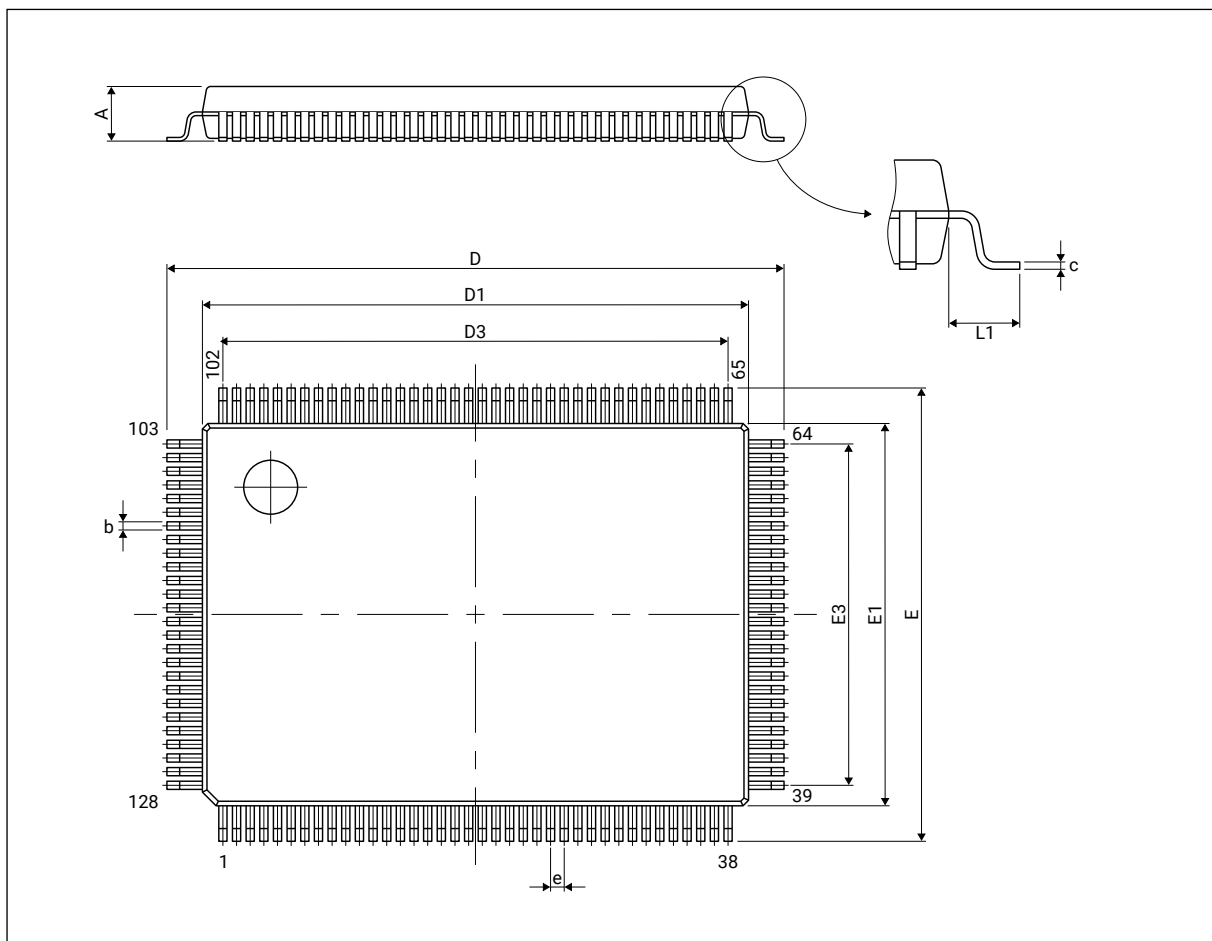
1. Drawing is not to scale.

Table 3: QFP-128 mechanical data

Symbol	Millimeters	Inches
A	2.000	0.0787
b	0.300	0.0118
c	0.100	0.0039
D	22.600	0.8898
D1	20.000	0.7874
D3	18.500	0.7283
E	16.600	0.6535
E1	14.000	0.5512
E3	12.500	0.4921
e	0.500	0.0197
L1	1.300	0.0512

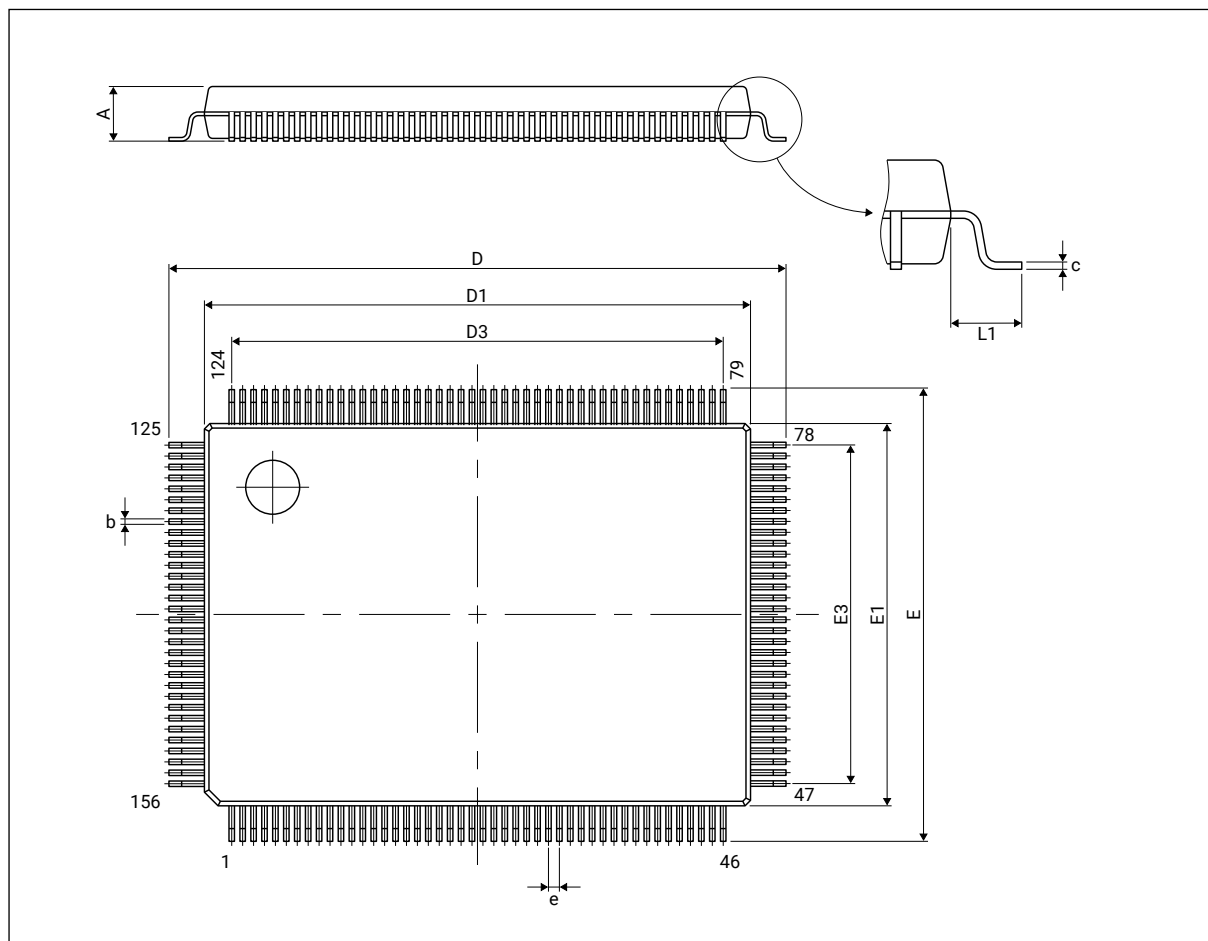1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 6: Recommended footprint for QFP-128 package

1. Dimensions are expressed in millimeters.

7.2 QFP-156 Package Information

Figure 7: QFP-156 package outline

1. Drawing is not to scale.

Table 4: QFP-156 mechanical data

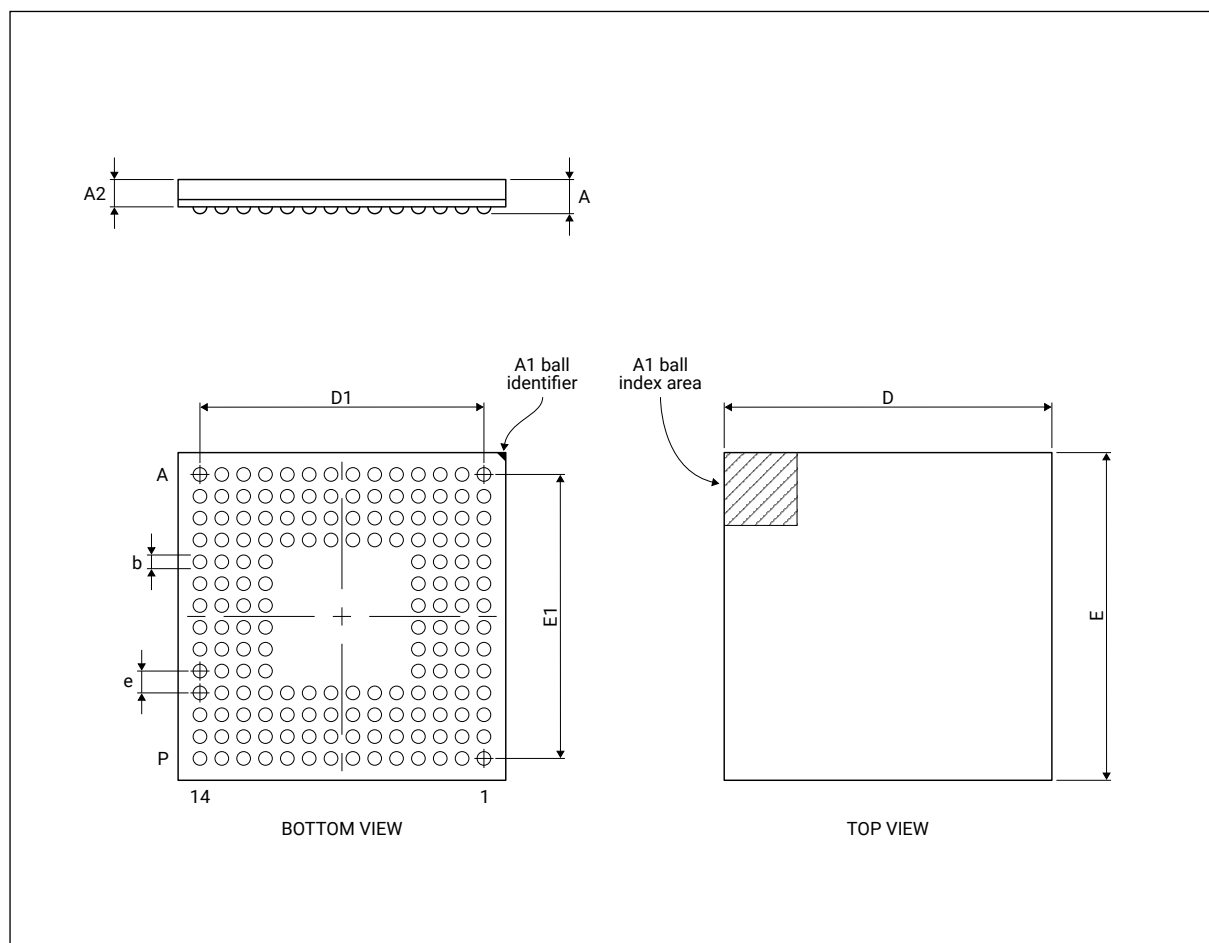| Symbol	Millimeters	Inches
A	2.000	0.0787
b	0.200	0.0079
c	0.100	0.0039
D	22.600	0.8898
D1	20.000	0.7874
D3	18.000	0.7087
E	16.600	0.6535
E1	14.000	0.5512
E3	12.400	0.4882
e	0.400	0.0157
L1	1.300	0.0512

1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 8: Recommended footprint for QFP-156 package
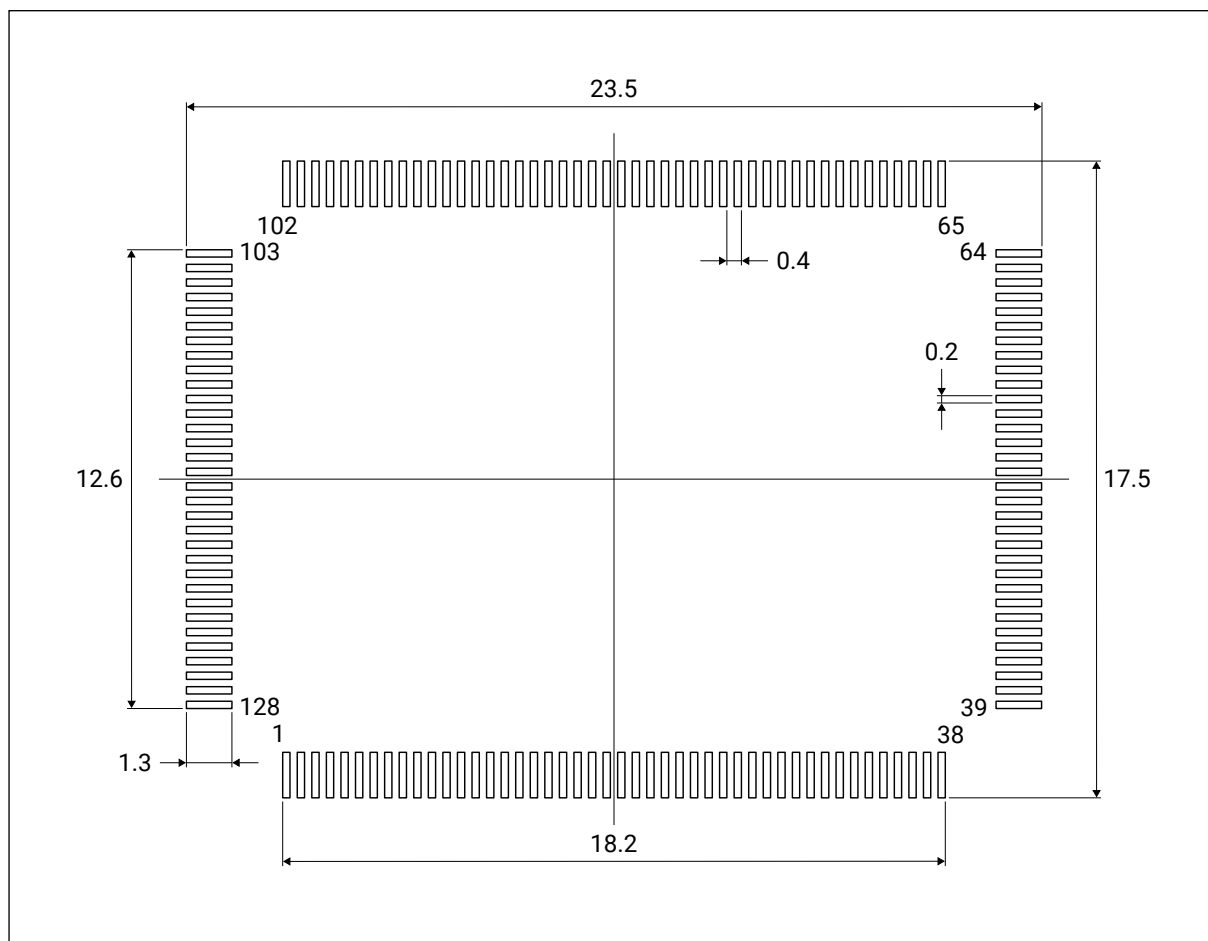
1. Dimensions are expressed in millimeters.

7.3 CSP-BGA-160 Package Information
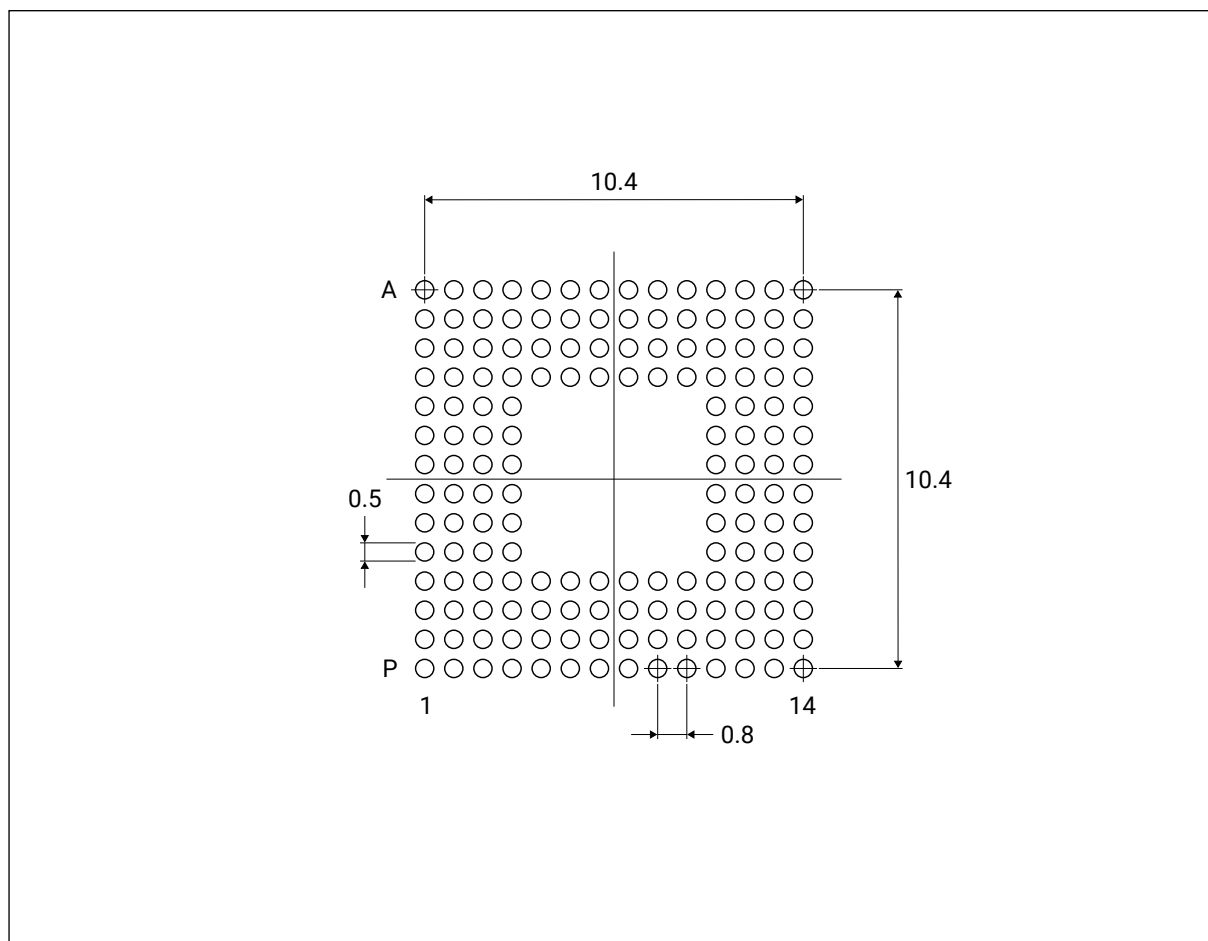
Figure 9: CSP-BGA-160 package outline

1. Drawing is not to scale.

Table 5: CSP-BGA-160 mechanical data

Symbol	Millimeters	Inches
A	1.400	0.0551
A2	1.000	0.0394
b	0.500	0.0197
D	12.000	0.4724
D1	10.400	0.4094
E	12.000	0.4724
E1	10.400	0.4094
e	0.800	0.0315

1. Values in inches are converted from mm and rounded to 4 decimal digits.

Figure 10: Recommended footprint for CSP-BGA-160 package

1. Dimensions are expressed in millimeters.

8 Revision History

Table 6: Revision history

Date	Revision	Changes
2025-08-29	0	Initial release

9 Sources

[1] NOCASH, "GBATEK", https://problemkaputt.de/gbatek.htm

[2] gbadev, "gbadoc", https://gbadev.net/gbadoc

[3] RetroSix, "Schematics (Game Boy Advance)", https://www.retrosix.wiki/schematics-game-boy-advance

[4] Gekkio, "gb-schematics", https://github.com/Gekkio/gb-schematics

[5] HDR, "Game_Boy_Micro_Schematic", https://github.com/HDR/Game_Boy_Micro_Schematic

[6] nataliethenerd, "boardscans", https://github.com/nataliethenerd/boardscans

[7] SHARP, "LQ035Q7DH07 LCD Module", https://www.mouser.com/datasheet/2/365/LQ035Q7DH07N_SPEC_LD-21910A-184021.pdf