aMTP64M Datasheet

16 bit DSP Multi-Time Program Voice IC

Feature

- 16-bit RISC DSP

- 4-Stage Pipeline， 1 Clock Cycle per Instruction

- System Speed : 32K~33M Hz (33 MIPS)

- Built-in 2M Hz RCoscillator (±0.5%)

- Clock Sources :32768 Hz / 4M Hz / PLL (Clock from P0)

- Built-in 16K Words (32K Bytes) ROM (OTP)

- Built-in 4K Words (8K Bytes) SRAM

- Built-in 64M bits SPI FLASH memory

- 22~88 minutes Voice Length at 10K~38K sampling compression.

- Built-in 40-bit MAC (Multiply Accumulator)

- MAC signed / unsigned saturate operation

- ALU signed saturate operation

- Built-in 1x 16-bit Timer and 2x 14-bit Timer

- 3x 8/10bits PWM I/O output

- 2x OP Amplifier

■ 1 interpolation generator enhancing SNR

■ 8x GPIO for customer usage

■ Programmable outputs pin for BUSY and LED Flash

■ Built-in 100mA LDO，2.6/2.8/3.0/3.2V optional

■ Built-in 4 levels LVD（low voltage detect）

■ Built-in Watch Dog Timer

■ 1x SPI，Standard/Dual/Quoad SPI protocol

■ 1x 16 bit ΔΣ Multi-Level DAC

■ 1x 10/11/12 bits PWM Speaker Amplifier(3 driving levels)

■ Operating Voltage : 2.7V~5.1V（LVR default is 2.4V）

■ Standby current: Tpy. 2uA

Flash-Duration Size Table

| CR2 --- Sample rate (Hz) for 64M SPI FLASH								
S.R.	*6000*	*8000*	*10000*	*11025*	*12000*	*14000*	*16000*	*18000*	*20000*
K bps	*7.2*	*9.59*	*12*	*13.22*	*14.99*	*17.5*	*19.98*	*22.48*	*24.99*
Second	*9319*	*6993*	*5592*	*5074*	*4475*	*3835*	*3358*	*2984*	*2685*
CR2 --- Sample rate (Hz) for 64M SPI FLASH								
S.R.	*22000*	*22050*	*24000*	*26000*	*28000*	*30000*	*32000*	*38000*	*44100*
K bps	*27.49*	*29.98*	*29.98*	*32.46*	*34.99*	*37.47*	*39.95*	*47.49*	*55.07*
Second	*2440*	*2436*	*2238*	*2067*	*1918*	*1791*	*1679*	*1413*	*1218*

Function Mode

1. MCU Serial Interface

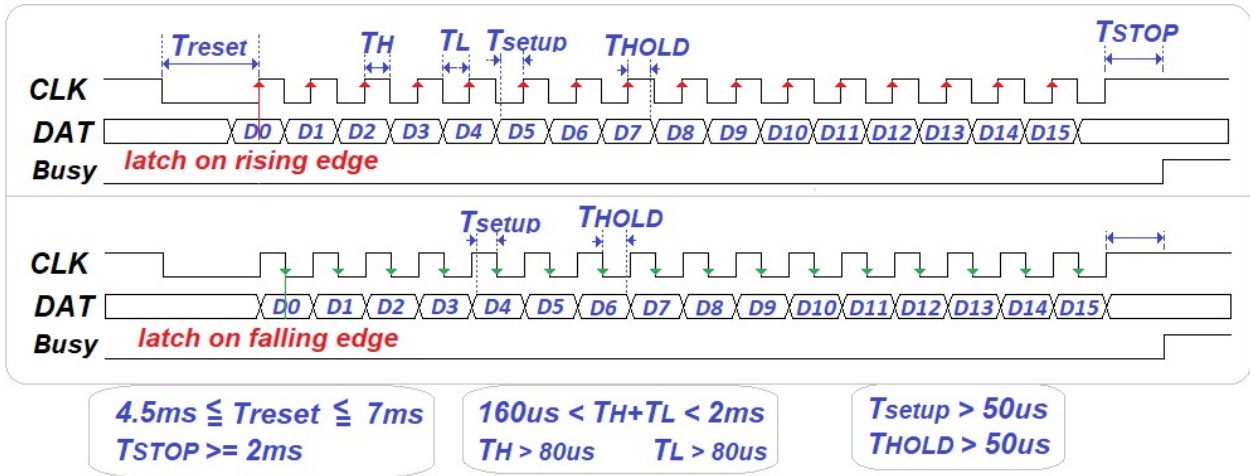8 I/O (P0,P1,P2,P3,P4,P5,P6,P12) -- Each I/O can be setting /CS, DATA, CLK, BUSY

. **1- wire interface :CLK**

Each Pulse signal represents a Bit Value. The value is determined to be 0 or 1 according to Pulse Duty. When the ratio of Pulse Width is High: Low = 1:3, the Bit value is 0 ; High: Low = 3:1 the Bit value is 1
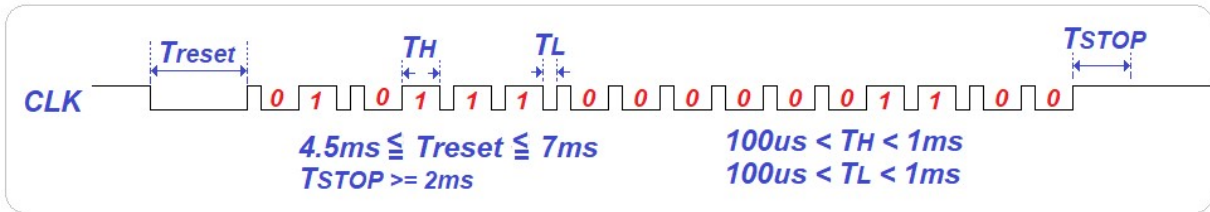
2- wire interface : CLK , DAT

Use 2 signal Pins (CLK, DAT) for Cmd Code transmission.

2.1 Clock Pin: CLK, Data Pin: DAT

2.2 After Power On or H/W Reset, CLK is preset to High

2.3 The Setup Time and Hold Time of Data must be at least 50 us

2.4 Clock's High Pulse and Low Pulse must be longer than 80 us and shorter than 2 ms

2.5 When the CLK Low Pulse width >= 4.5ms, it will be regarded as Reset Signal, wake up amtp64m and reset Cmd Bits reception

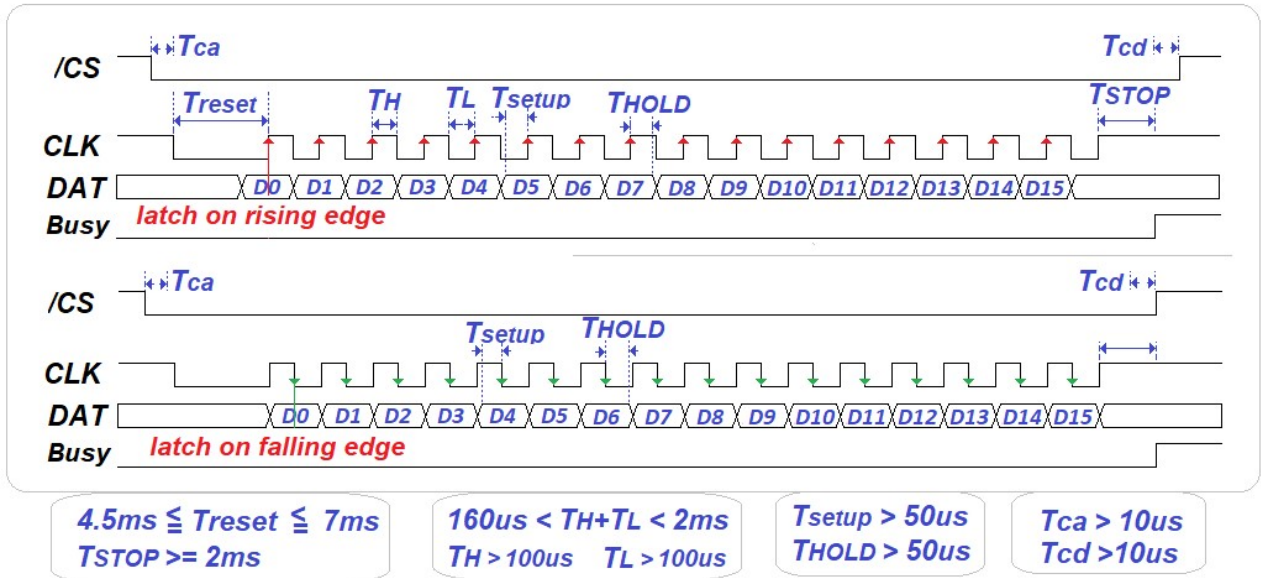2.6 The first Low Pulse of CLK must be a Reset signal (width >= 4.5ms)

2.7 When receiving Cmd Bits, if CLK = High $\geqq$ 2ms, it is regarded as Stop Signal. If Bit Count is correct , then interpret the Cmd Code action, otherwise no action.
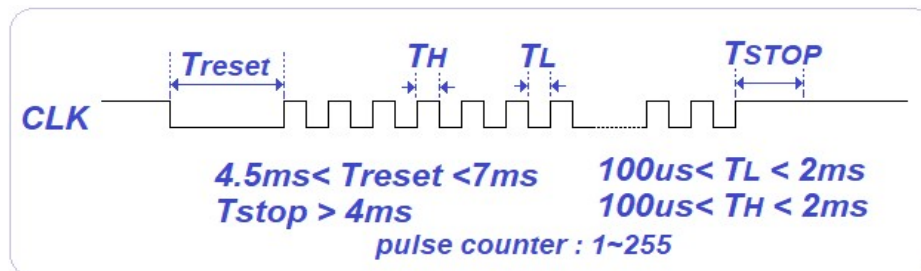
2.8 If there is no action, start Idle Time counting to enter Sleep

3- wire interface : /CS,CLK , DAT

Use 3 signal Pins (/CS, CLK, DAT) for Cmd Code transmission. H3W transmits Cmd Code in the same way as H2W, but H3W Interface is only available on the chip select pin (/CS) action at Low. If /CS returns to High during transmission, Abort Command.

$4.5ms \leqq Treset \leqq 7ms$
$TSTOP >= 2ms$

$160us < TH+TL < 2ms$
$TH > 100us$ $TL > 100us$

$Tsetup > 50us$
$THOLD > 50us$

$Tca > 10us$
$Tcd > 10us$

Pulse counting interface

$4.5ms < Treset < 7ms$
$Tstop > 4ms$

$100us < TL < 2ms$
$100us < TH < 2ms$

pulse counter : 1~255

4.1 Pulse Rx Pin: Rx

4.2 The first Low Pulse width must be >= 4.5 ms

4.3 When Low Pulse width >= 4.5 ms, wake up H9 and reset Pulse Counter to 0, restart counting

4.4 When the High Pulse width >= 4ms, the calculation ends, and the specified Sentence will be played according to the Pulse Count

4.5. After PowerOn or H/W Reset, Rx is preset to High

4.6. Pulse Counter accumulates the number of Rising Edges of Rx. When the number exceeds 255, the abnormal operation will be ignored

4.7. After finishing receiving codes, immediately stop the current action and play the newly designated Sentence

4.8. If there is no action, start Idle Time counting to enter Sleep

APLUS INTEGRATED CIRCUITS INC---aMTP64M

Normal command	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Play section(N)-once time	0	1	1	0	0	0	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Play section(N)-LOOP	0	1	1	0	1	1	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Play sentence(n)-once time	0	1	0	1	0	0	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Play sentence(n)-LOOP	0	1	0	1	1	1	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Play next section	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	1
Play previous section	0	0	0	1	1	0	1	0	0	0	1	0	0	0	1	0
Play next sentence	0	0	0	1	1	0	1	0	0	1	0	1	0	1	0	1
Play previous sentence	0	0	0	1	1	0	1	0	0	1	1	0	0	1	1	0
Sleep	0	0	0	1	1	0	1	0	1	0	1	0	1	0	1	0
Stop	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	1
Pause/resume	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	0
VOL = VOL + N	0	1	0	0	1	1	0	0	1	1	0	0	N = (D3~D0)+1, 1~16			
VOL = VOL – N	0	1	0	0	1	1	0	0	1	0	0	1	N = (D3~D0)+1, 1~16			
Set VOL	0	1	0	0	1	1	0	0	0	N = (D6~D0), 0 ~ 127						

Table play command	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Push cmd (play+mute)	1	0	0	1	0	1	Play section(N) , (N = D9~D0 , 1024 sections)									
Push cmd(set mute length)	1	0	0	1	1	1	Set MuteTime(M) { N= D[9:0] , M = 16ms * N }									
Table play start go	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0

- Play Section Command :
  Command : 0-1-1-0 -0-0-a9-a8 -a7-a6-a5-a4 -a3-a2-a1-a0 ….. play once time
  Command : 0-1-1-0 -1-1-a9-a8 -a7-a6-a5-a4 -a3-a2-a1-a0 ….. play loop
  D[9:0] : Voice Section Index (0 ~ 1023)

  Play Section Cmd is Imm-Cmd (execute immediately). After receiving this Cmd, when Index is valid, stop the current action and play the specified Voice Section immediately. If D[11:10] = 0x3, the specified Section will be played continuously

- Play Sentence Command:
  Command : 0-1-0-1 -0-0-a9-a8 -a7-a6-a5-a4 -a3-a2-a1-a0 ….. play once time
  Command : 0-1-0-1 -1-1-a9-a8 -a7-a6-a5-a4 -a3-a2-a1-a0 ….. play loop
  D[9:0] : Sentence Index (0 ~ 1023)

  Play Sentence Cmd is Imm-Cmd (execute immediately). After receiving this Cmd, when the Index is valid, the current action is aborted, and the specified Sentence is played immediately. If D[11:10] = 0x3, the specified Sentence will be played continuously. This Cmd does not change the Section Index value.

- Play Next Section Command:
  Command : [1A11]   0-0-0-1 -1-0-1-0 -0-0-0-1 -0-0-0-1

  Play NextSection Cmd is Imm-Cmd (Execute immediately). After receiving this Cmd, the current action is aborted and the next Voice Section is played immediately. .

- Play Previous Section Command:
  Command : [1A22]   0-0-0-1 -1-0-1-0 -0-0-1-0 -0-0-1-0

  Play PreviousSection Cmd is Imm-Cmd (Execute immediately). After receiving this Cmd, the current action is aborted and the previous Voice Section is played immediately.

- Play Next Sentence Command:
  Command : [1A55]   0-0-0-1 -1-0-1-0 -0-1-0-1 -0-1-0-1

  Play Next Sentence Cmd is Imm-Cmd (Execute immediately), after receiving this Cmd, the current action is aborted, and the next Voice Sentence is played immediately

- Play Previous Sentence Command:
  Command : [1A66]   0-0-0-1 -1-0-1-0 -0-1-1-0 -0-1-1-0

  Play Previous Sentence Cmd is Imm-Cmd (Execute immediately). After receiving this Cmd, the current action is aborted and the previous Voice Sentence is played immediately.

- Pause / Resume Command:
  Command : [1A18]   0-0-0-1 -1-0-1-0 -0-0-0-1 -1-0-0-0

  This is Imm-Cmd (execute immediately).After receiving this Cmd, the playback will be paused while it is playing, and the playback will continue if it has been paused, and it will be ignored when there is no action.

- Sleep Command:
  Command : [1AAA]   0-0-0-1 -1-0-1-0 -1-1-0-0 -1-1-0-0

  Sleep Cmd is Imm-Cmd, after receiving this Cmd, the current action will be aborted and the Sleep Mode will be entered.

- Stop Command:
  Command : [1A81]   0-0-0-1 -1-0-1-0 -1-0-0-0 -0-0-0-1

  Stop Cmd is Imm-Cmd, after receiving this Cmd, stop the current action and enter Idle Mode

- Set-Volume Command:
  Command : [4Cxx]   0-1-0-0 -1-1-0-0 -0-D6-D5-D4 –D3-D2-D1-D0
  D[6:0] : Volume (0 ~ 127) ,

  Set-Volume Cmd is Imm-Cmd. After receiving this Cmd, the current Cmd will not be interrupted and the Volume value will be changed immediately.

- Inc-Volume Command:
  Command : [4CCx]   0-1-0-0 -1-1-0-0 -1-1-0-0 –D3-D2-D1-D0
  D[3:0] :   (0~15)+1

  This is Imm-Cmd. After receiving this Cmd, without interrupting the current Cmd, immediately increase the Volume value N = D[3:0]+1.

▪ Dec-Volume Command:

Command : [4C9x]   0-1-0-0 -1-1-0-0 -1-0-0-1 –D3-D2-D1-D0

D[3:0] :   (0~15)+1

This is Imm-Cmd. After amtp64m receives this Cmd, it does not interrupt the current Cmd and immediately reduces the Volume value N = D[3:0]+1.

▪ Table Play

Table Play refers to maintaining a Cmd Queue with a depth of at least 20 words. Host first pushes the Cmd that needs to be executed, and finally sends the Table-Play start Go Cmd to amtp64m, and amtp64m will execute the Cmd in the Queue in batches. Table- Play Cmd includes:

(1) Push (Play+Mute)

Command : [9xxx]   1-0-0-1 -0-1-D9-D8 –D7-D6-D5-D4 –D3-D2-D1-D0

Push a Play Voice Cmd, amtp64m does not interrupt the current Cmd

(2) Push (SetMuteTime)

Command : [9xxx]   1-0-0-1 -1-1-D9-D8 –D7-D6-D5-D4 –D3-D2-D1-D0

Push a setting Set MuteTime Cmd, amtp64m does not interrupt the current Cmd During each Play Cmd execution, there will be a Mute interval, the default Mute Time is 0, and it can be changed with SetMuteTime.
Set MuteTime(M) {N = D[9:0], M = 16ms * N}

(3) Table-Play Go

Command : [9090]   1-0-1-0 -0-0-0-0 -1-0-0-1 -0-0-0-0

Able-Play Go is an Imm-Cmd. After amtp64m receives Cmd, it aborts the current action and clears MuteTime = 0, and immediately executes the Cmd List in the Queue.

EX:
1. *Send command [9401] set mute time : 1001-1100-0000-1101   ; 16ms x 13=208ms*
2. *Send command [9401] play-01 : 1001-0100-0000-0001*
3. *Send command [9405] play-05 : 1001-0100-0000-0101*
4. *Send command [9408] play08 : 1001-0100-0000-1000*
5. *Send command [940C] play12 : 1001-0100-0000-1100*
6. *Send command [9090] table play start go : 1001-0000-1001-0000 ….*
   Start Play: Play01 + delay208ms + play05 + delay208ms + play08 + delay208ms +
          play12

2. Table Speech Mode

8 I/O setting options : P0(Input pin only),P1,P2,P3,P4,P5,P6,P12

a. Power on play

b. Trigger mode option : EUR, EUI,LHR,LHI,EHR, LUR,LUI, on off

c. Play one time or loop

d. Multi sequential play : Sequential play One Time or Loop or On Off

Each I/O can define first sentence and last sentence voice in order.

For Example : Set P1 Sequential play Loop with On Off from Sentence 6 to 8

P1 will be played following sentences in sequential

S6 loop, off, S7 loop, off,S8 loop, off, S6 loop, off, S7…etc

Fig.1 to Fig.4 show the voice playback with different combination of triggering mode and the relationship between outputs and voice playback.
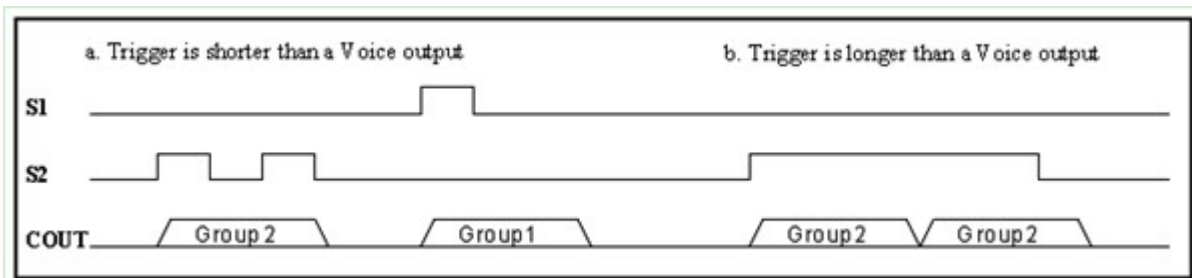

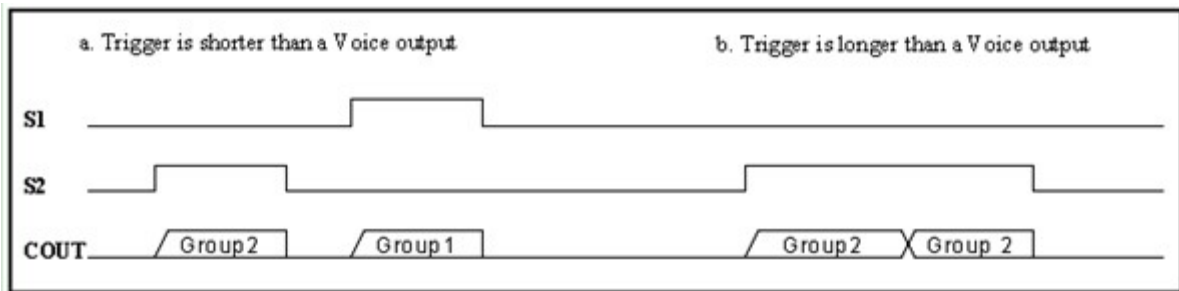Fig.1   Level, Unholdable, Ir-retriggerable
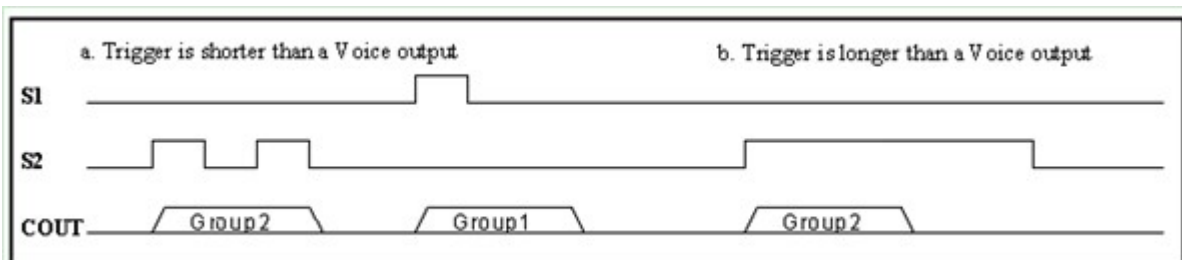

Fig. 2   Level Holdable

Fig. 3 Edge, Unholdable, Ir-retrigger
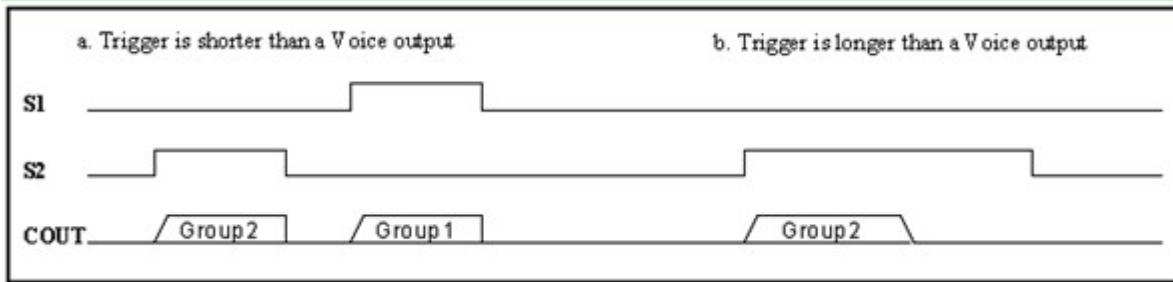
Fig. 4   Edge, Holdable

3. MP3 mode function table

I/O Pin	Action	Loop Option	
		LoopOn	LoopOff
P00	Forward Play	Play in loop	Play one time
P01	Backward Play		
P02	Play/Pause key		
P03	Play/Stop key		
P04	Play All/Stop key		
P05	Volume key from Level 6 to Level 0		

▪ PIN ASSIGNMENT :

Pad No	Designation	I/O	Description
1	LDO	P	System Core LDO 2.6/2.8/3.0/3.2V
2	SPI-Hold	I/O	SPI Hold or Reset input
3	SPI-VCC	P	SPI Power Supply
4	VCC	P	System Power Supply
5	SPI-DO	I/O	SPI Serial Data Pin
6	SPI-CS	I	SPI Chip Enable
7	P0	I/O	LDO/VCC Port I/O 0
8	AVCC	P	Analog (Speaker) Power Supply
9	SPKP	O	Speaker Positive / DAC output
10	SPKN	O	Speaker Negative
11	VPP	P	OTP-memory program voltage
12	P1	I/O	LDO/VCC Port I/O 1
13	P2	I/O	LDO/VCC Port I/O 2
14	P3	I/O	LDO/VCC Port I/O 3
15	P4	I/O	LDO/VCC Port I/O 4

16	P5	I/O	LDO/VCC Port I/O 5
17	P6	I/O	LDO/VCC Port I/O 6
18	P7	I/O	LDO/VCC Port I/O 7 SPI_CS
19	P8	I/O	LDO/VCC Port I/O 8 SPI_CLK
20	P9	I/O	LDO/VCC Port I/O 9 SPI_DO
21	P10	I/O	LDO/VCC Port I/O 10 SPI_DI
22	P11	I/O	LDO/VCC Port I/O 11 PWM-0 SPI_IO2
23	P12	I/O	LDO/VCC Port I/O 12
24	GND	P	System Ground
25	SPI-WP	I/O	SPI Write Protec
26	SPI-DI	I/O	SPI Serial Data Pin
27	SPI-CLK	I	SPI Serial Clock Pin
28	Resetb	I	System Reset.

- **DC Feature :**

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
P0~P12	Driving Current		4		mA	VOH = 2.7
P0~P12	Sink Current		8		mA	VOL = 0.3
DAC	Driving Current		4		mA	
PWM	Driving Current		170/130/90		mA	AmpDrvCap 3/2/1
I (std)	Standby Current			2	uA	
Input High Voltage	All Input	2.0		3.3	V	
Input Low Voltage	All Input	-0.3		0.8	V	
Voltage	Operation Voltage	2.7	3.3	5.1	V	
Temperature	Operation Temperature	0		70	℃	

- **APPLICATION CIRCUIT**
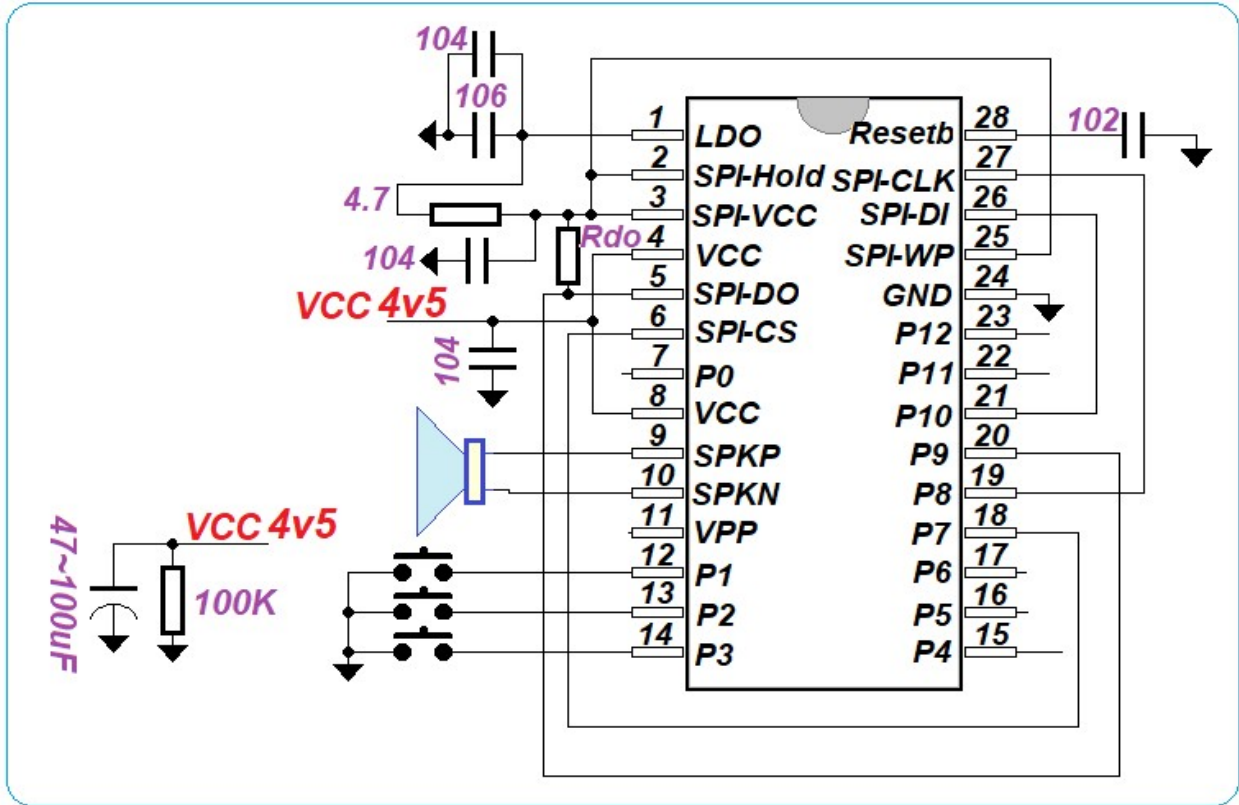
- *Package : SOP28 (300 MIL)*
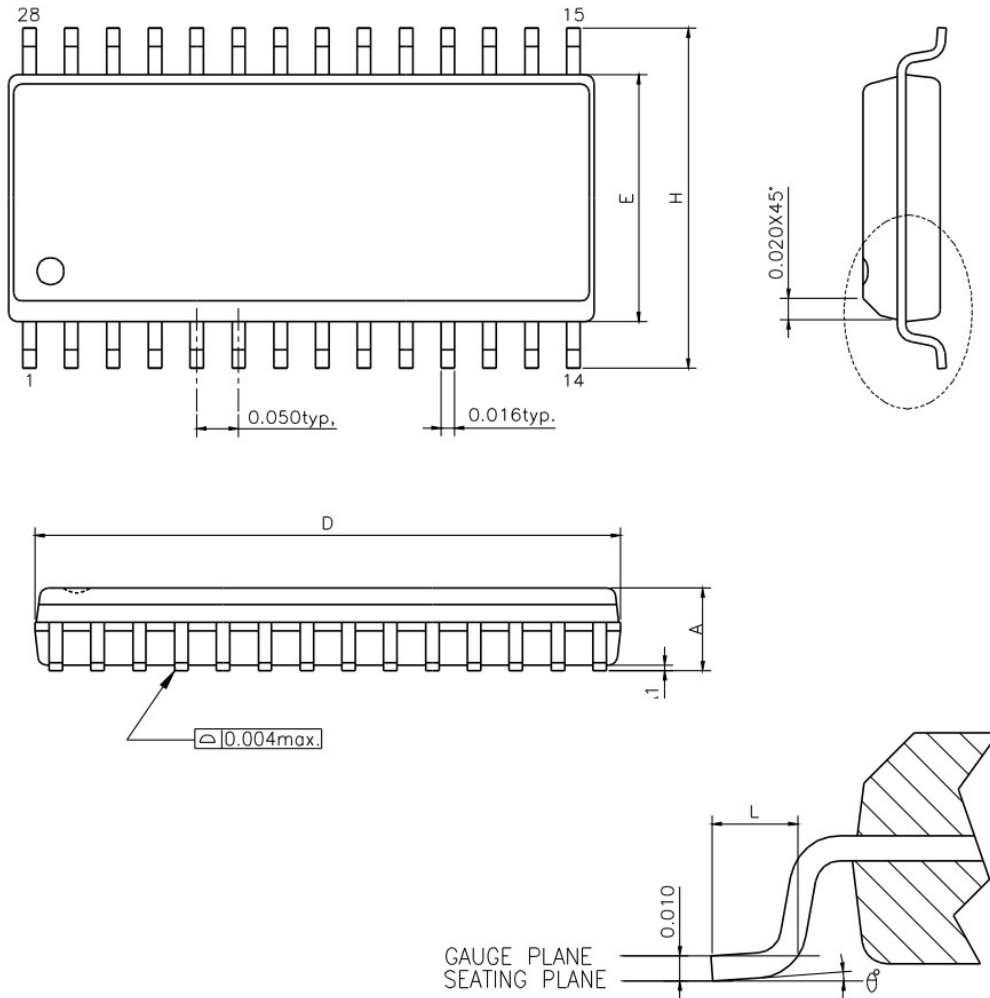
SYMBOLS	MIN.	NOM	MAX.
A	–	–	0.104
A1	0.004	–	–
D	0.697	0.718	0.724
E	0.291	0.295	0.299
H	0.394	0.406	0.419
L	0.016	0.035	0.050
θ°	0	4	8

UNIT : INCH

NOTES:
1. JEDEC OUTLINE : MO-119 AB
2. DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .25mm (.010in) PER SIDE.
3. DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.010in) PER SIDE.

■ **HISTORY**

Ver 1.0	05/05/2021
The 1St version datasheet for aMTP64M.	
Ver 1.1	20/08/2021
Modify page.12 APPLICATION CIRCUIT	
Ver 1.2	22/04/2022
Modify page.12 APPLICATION CIRCUIT add Rdo	