

# *aMTP32MK*

## *Datasheet*

*Multi-time program voice IC*

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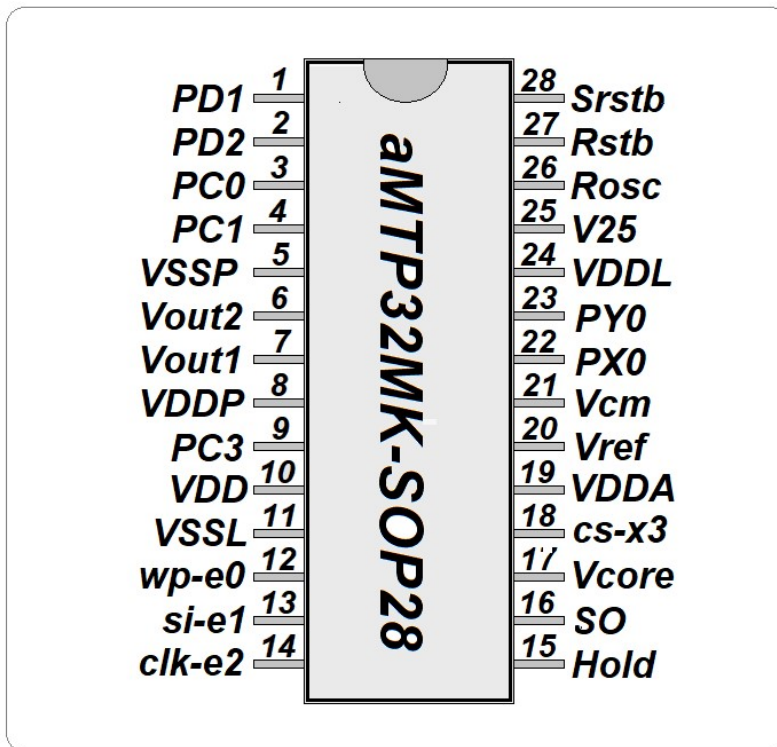
**■ FEATURES**

- *Standard CMOS process.*
- *8-bit PCM voice quality.*
- *Powerful 16-Bits Digital Audio Processor.*
- *Support 6KHz to 20KHz sampling.*
- *Support multi-sampling voice in one chip.*
- *660 sec voice length at 6KHz sampling or 200 sec voice length at 20KHz sampling.*
- *Up to 100,000 time for ROM program/erase cycles.*
- *Combination of voice building blocks to extend playback duration.*
- *Table entries are available for voice slice combinations.*
- *Five standard triggering modes are available (controlled by software):*
  - ◆ *Key Trigger mode*
  - ◆ *Sequential mode*
  - ◆ *CPU Parallel mode*
  - ◆ *CPU Serial mode*
  - ◆ *MP3 mode*
- *Voice section trigger options: Edge / Level; Hold / Un-hold; Retrigger / Non-retrigger.*
- *Built-in oscillator with fixed Rosc, software control sampling frequency*
- *2.7V ~ 6.5V single power supply and < 15uA stand-by current.*
- *PWM Vout1 and Vout2 drive speaker directly.*
- *D/A COUT with ramp-up ramp-down option to drive speaker through external BJT or amplifier.*
- *RSTB provides external controlled reset to the chip.*

**■ DESCRIPTION**

*Aplus' aMTP32MK series is multi-time program voice IC. It is fabricated with Standard CMOS process with voice storage flash memory. Offer five trigger modes: Key trigger mode, sequential mode, CPU parallel mode, CPU serial mode and MP3 mode, facilitate different user interface. User selectable triggering and output signal options provide maximum flexibility to various applications. External resistor ROSC control oscillator, 8-bit resolution current mode D/A output and PWM direct speaker driving minimize the number of external components.*

■ **PIN CONFIGURATION**



■ **PIN CONFIGURATION**

Pin Names	Pin	Description
VOUT1	7	PWM output to drive speaker directly
VOUT2	6	PWM output to drive speaker directly D/A current output ( VOUT1 pull high 1K ohm )
VSSL	11	Ground
VSSP	5	
Rosc	26	Oscillator input
VDD	10	Supply voltage
VDDA	19	
VDDP	8	
VDDL	24	
/HOLD	15	Data memory hold
WP-E0	12	Data memory write protect
CE-X3	18	Data memory enable
CLK-E2	14	Data memory serial data clock

<b>SO</b>	<b>16</b>	<b>Data memory serial data output</b>
<b>SI-E1</b>	<b>13</b>	<b>Data memory serial data input</b>
<b>PC0,PC1,PC3</b>	<b>3,4,9</b>	<b>I/O</b>
<b>PD1,PD2,PY0,PX0</b>	<b>1, 2, 23, 22</b>	<b>I/O</b>
<b>RSTB</b>	<b>27</b>	<b>Low active reset pin</b>
<b>Srstb</b>	<b>28</b>	<b>System reset, pull-down a resistor to the VSSL</b>
<b>V25</b>	<b>25</b>	<b>Internal LDO output.</b>
<b>Vcore</b>	<b>17</b>	<b>Positive power supply for core</b>
<b>Vcm</b>	<b>21</b>	<b>Common mode voltage</b>
<b>Vref</b>	<b>20</b>	<b>Reference voltage</b>

■ **TRIGGER MODES**

There are five trigger modes available for aMTP32MK:

- **Key Trigger mode**
- **Sequential mode**
- **CPU Parallel mode**
- **CPU Serial mode**
- **MP3 mode**

Below lists the how many I/Os will be use and simple description for every modes:

		<b>Input Pin</b>	<b>Maximum Section</b>	<b>Busy Output</b>	<b>Random Section Trigger</b>	<b>Section Option Support</b>
<b>Mode</b>	<b>Key Trigger</b>	<b>6</b>	<b>31</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	<b>Sequential</b>	<b>1</b>	<b>256</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>
	<b>CPU Parallel Trigger</b>	<b>6</b>	<b>32</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	<b>CPU Serial Command</b>	<b>2</b>	<b>256</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
	<b>MP3</b>	<b>5</b>	<b>256</b>	<b>Yes</b>	<b>No</b>	<b>No</b>

- **Key Trigger Mode**

Support simple random voice trigger. Can play up to 31 voice section by key combination. It also provides a **BUSY** output, the **BUSY** pin will output  $V_{IH}$  when voice playing.

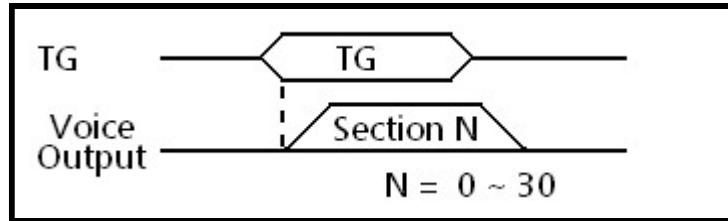
When **Section Option** pin is  $V_{IL}$ , up to 31 Voice Sections can be triggered by 6 **TG** pins showing at Table 1 .

**Section Option** pin default is  $V_{IL}$ .

- ◆ **Pin Defined**

<b>Pin Name</b>	<b>PC0</b>	<b>PC1</b>	<b>PX0</b>	<b>PC3</b>
<b>Description</b>	<b>TG</b>	<b>TG</b>	<b>TG</b>	<b>TG</b>
<b>Pin Name</b>	<b>PY0</b>	<b>PD1</b>	<b>PD2</b>	
<b>Description</b>	<b>BUSY</b>	<b>TG</b>	<b>TG</b>	

◆ Example



◆ Trigger Table

		TG Pin					
		PC0	PC1	PX0	PC3	PD1	PD2
Voice Section	0	HIGH	NC	NC	NC	NC	NC
	1	NC	HIGH	NC	NC	NC	NC
	2	NC	NC	HIGH	NC	NC	NC
	3	NC	NC	NC	HIGH	NC	NC
	4	NC	NC	NC	NC	HIGH	NC
	5	NC	NC	NC	NC	NC	HIGH
	6	HIGH	HIGH	NC	NC	NC	NC
	7	NC	HIGH	HIGH	NC	NC	NC
	8	NC	NC	HIGH	HIGH	NC	NC
	9	NC	NC	NC	HIGH	HIGH	NC
	10	NC	NC	NC	NC	HIGH	HIGH
	11	HIGH	NC	NC	NC	NC	HIGH
	12	HIGH	HIGH	HIGH	NC	NC	NC
	13	NC	HIGH	HIGH	HIGH	NC	NC
	14	NC	NC	HIGH	HIGH	HIGH	NC

		TG Pin					
		PC0	PC1	PX0	PC3	PD1	PD2
Voice Section	15	NC	NC	NC	HIGH	HIGH	HIGH
	16	HIGH	NC	NC	NC	HIGH	HIGH
	17	HIGH	HIGH	NC	NC	NC	HIGH
	18	HIGH	HIGH	HIGH	HIGH	NC	NC
	19	NC	HIGH	HIGH	HIGH	HIGH	NC
	20	NC	NC	HIGH	HIGH	HIGH	HIGH
	21	HIGH	NC	NC	HIGH	HIGH	HIGH
	22	HIGH	HIGH	NC	NC	HIGH	HIGH
	23	HIGH	HIGH	HIGH	NC	NC	HIGH
	24	HIGH	HIGH	HIGH	HIGH	HIGH	NC
	25	NC	HIGH	HIGH	HIGH	HIGH	HIGH
	26	HIGH	NC	HIGH	HIGH	HIGH	HIGH
	27	HIGH	HIGH	NC	HIGH	HIGH	HIGH
	28	HIGH	HIGH	HIGH	NC	HIGH	HIGH
	29	HIGH	HIGH	HIGH	HIGH	NC	HIGH
30	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	

Table 1. Trigger Table When Section Option Is V<sub>IL</sub>

● **Sequential Mode**

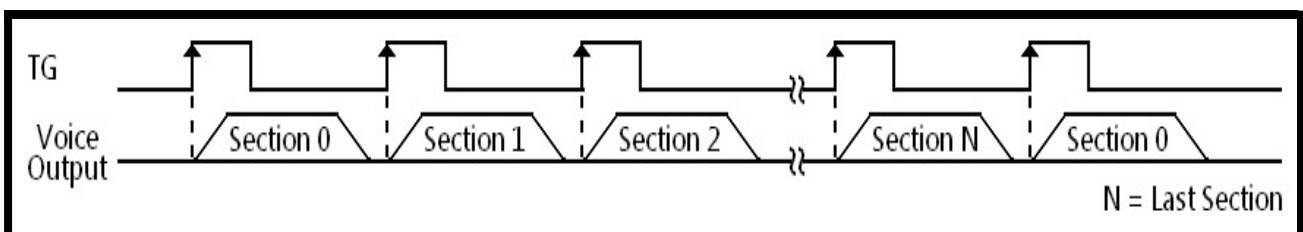
Support play up to 256 voice section sequentially by 1 **TG** pin. It also provides a **BUSY** output, the **BUSY** pin will output  $V_{IH}$  when voice playing.

When **TG** pin rising edge, chip will play voice. Rising edge again, then play next voice section. When last voice section is played, chip will return to voice section 0.

◆ **Pin Defined**

<b>Pin Name</b>	<b>PC0</b>	<b>PC1</b>	<b>PX0</b>	<b>PX3</b>
<b>Description</b>	<b>TG</b>	N.C.	N.C.	N.C.
<b>Pin Name</b>	<b>PY0</b>	<b>PD1</b>	<b>PD2</b>	
<b>Description</b>	<b>BUSY</b>	N.C.	N.C.	

◆ **Example**





- **CPU Parallel Mode**

- ◆ **Summary**

Support up to 32 voice section random play by 5 **Addr** pins and a **TG** pin. User assign voice section by **Addr** pins, and voice will play when **TG** pin rising edge. It also provides a **BUSY** output, the **BUSY** pin will output  $V_{IH}$  when voice playing.

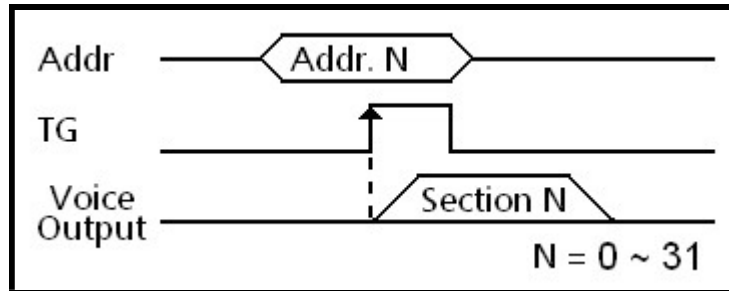
- ◆ **Pin Defined**

<b>Pin Name</b>	<b>PC0</b>	<b>PC1</b>	<b>PX0</b>	<b>PC3</b>
<b>Description</b>	<b>Addr[ 0 ]</b>	<b>Addr[ 1 ]</b>	<b>Addr[ 2 ]</b>	<b>Addr[ 3 ]</b>
<b>Pin Name</b>	<b>PY0</b>	<b>PD1</b>	<b>PD2</b>	
<b>Description</b>	<b>BUSY</b>	<b>Addr[ 4 ]</b>	<b>Trigger</b>	

**P.S.**

1. **Addr[0] ~ Addr[4]** are Section number in binary digit.
2. **Addr[0]** is the LSB (least signification bit), **Addr[4]** is the MSB (most signification bit).

◆ *Example*



*Addr[4] ~ Addr[0] = 00000 => Play Section #0*

*Addr[4] ~ Addr[0] = 00001 => Play Section #1*

*...*

*Addr[4] ~ Addr[0] = 11110 => Play Section #30*

*Addr[4] ~ Addr[0] = 11111 => Play Section #31*

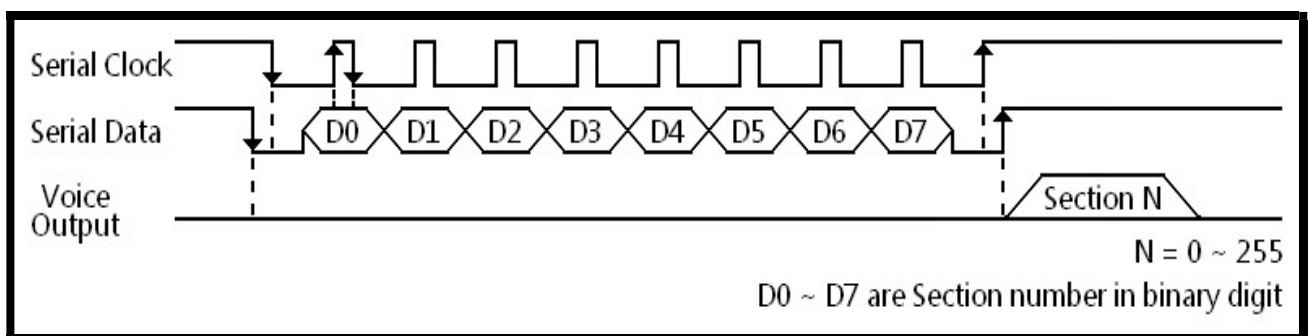
● **CPU Serial Mode**

The CPU serial mode is designed for CPU interface. The host CPU can send data to control aMTP32MK. **Serial Clock** and **Serial Data** are used to input section number. **BUSY** is output from the chip to the host CPU for feedback response. Maximum 256 voice section are available.

◆ **Pin Defined**

<b>Pin Name</b>	<b>PC0</b>	<b>PC1</b>	<b>PX0</b>	<b>PC3</b>
<b>Description</b>	<b>Serial Clock</b>	<b>Serial Data</b>	<b>N.C.</b>	<b>N.C.</b>
<b>Pin Name</b>	<b>PY0</b>	<b>PD1</b>	<b>PD2</b>	
<b>Description</b>	<b>BUSY</b>	<b>N.C.</b>	<b>N.C.</b>	

◆ **Example**



- **MP3 Mode**

User can start to play the voice or pause current voice by **Play/Pause** pin, and forward or backward play by **Forward** pin or **Backward** pin, up to 256 Voice Sections.

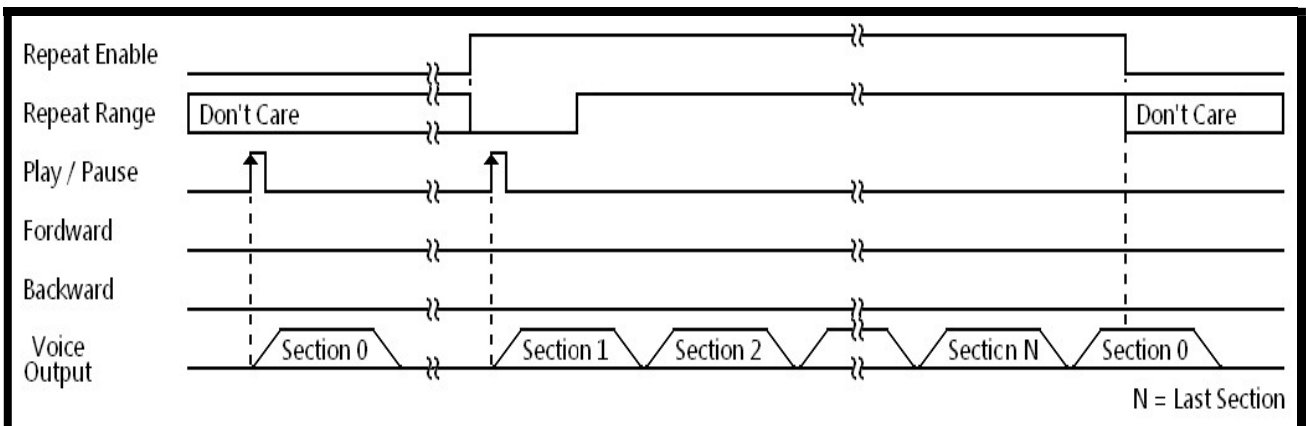
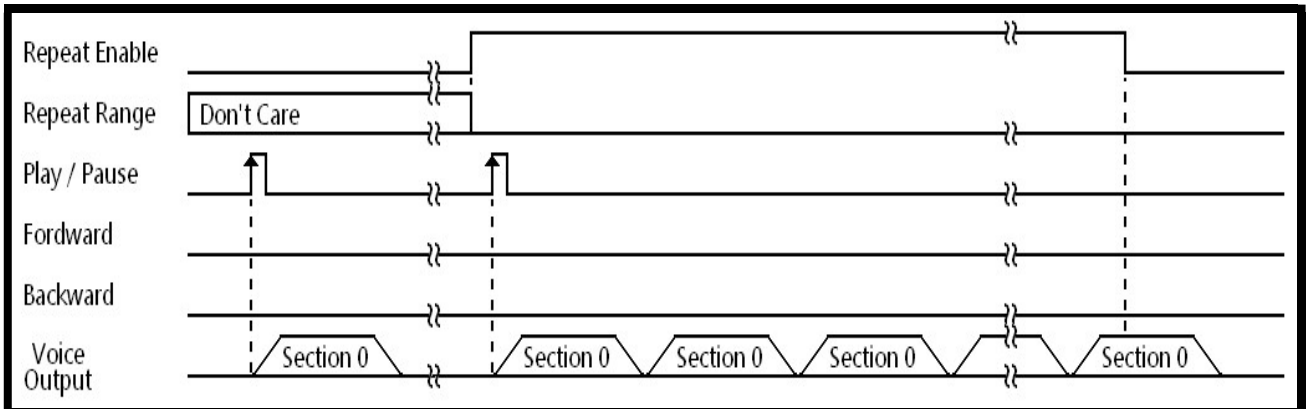
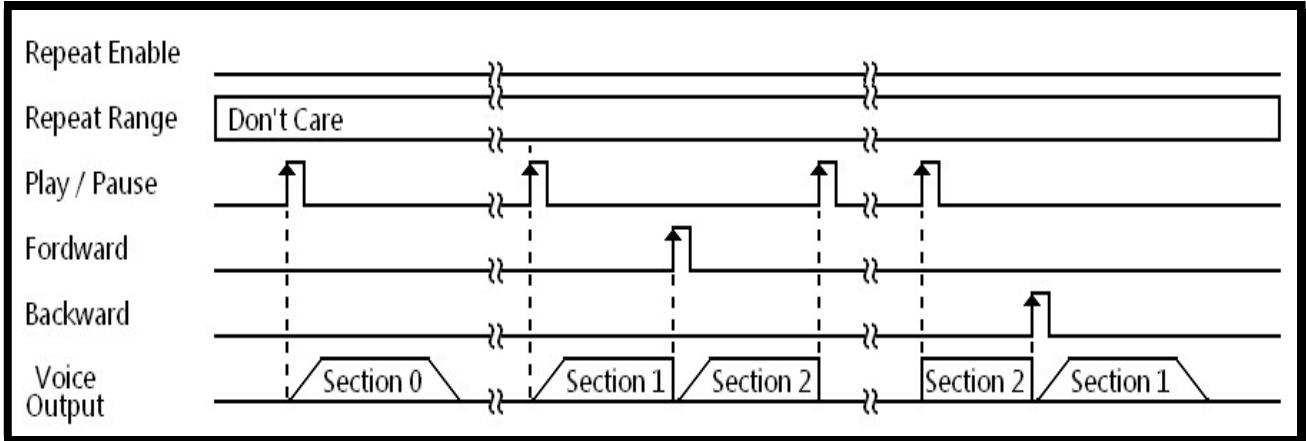
User can enable repeat function by **Repeat Enable** pin. When repeat enable, it will loop play the current voice section by **Repeat Ranges** pin is  $V_{IL}$ ; It will loop play all the voice section sequentially by **Repeat Range** pin is  $V_{IH}$ .

**Repeat Enable** pin and **Repeat Range** pin default is  $V_{IL}$ .

- ◆ **Pin Defined**

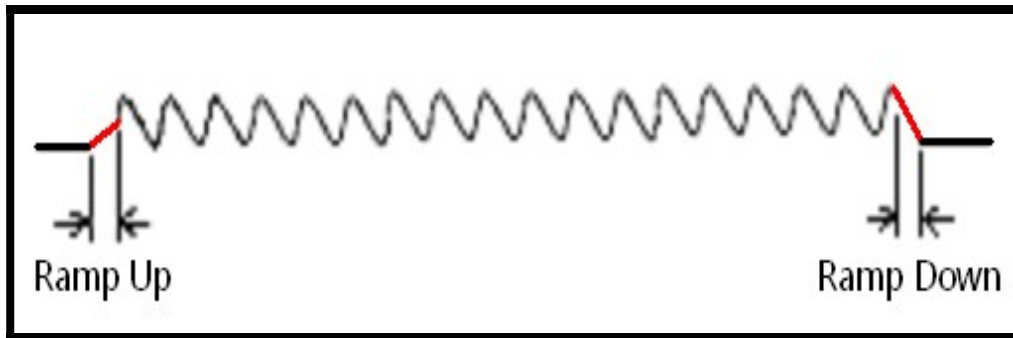
<b>Pin Name</b>	<b>PC0</b>	<b>PC1</b>	<b>PX0</b>	<b>PC3</b>
<b>Description</b>	<b>Forward</b>	<b>Play Pause</b>	<b>Backward</b>	<b>N.C.</b>
<b>Pin Name</b>	<b>PY0</b>	<b>PD1</b>	<b>PD2</b>	
<b>Description</b>	<b>BUSY</b>	<b>Repeat Enable</b>	<b>Repeat Range</b>	

◆ **Example**



■ **RAMP UP / RAMP DOWN**

When playback in DAC, Ramp Up /Ramp Down will enabled. This function eliminates the ‘POP’ noise at the begin and end of voice playback.



*Fig. 1 Ramp-up-down Enable*

■ **VOICE TABLE**

One voice section can include many voice slices. User can use voice slices to save memory usage. For example, we have 3 voice file store in the memory:

*File 1: “How are You?”*

*File 2: Sound Effect*

*File 3: Music*

Voice slices are grouped together using Voice Table to form Voice Section for playback:

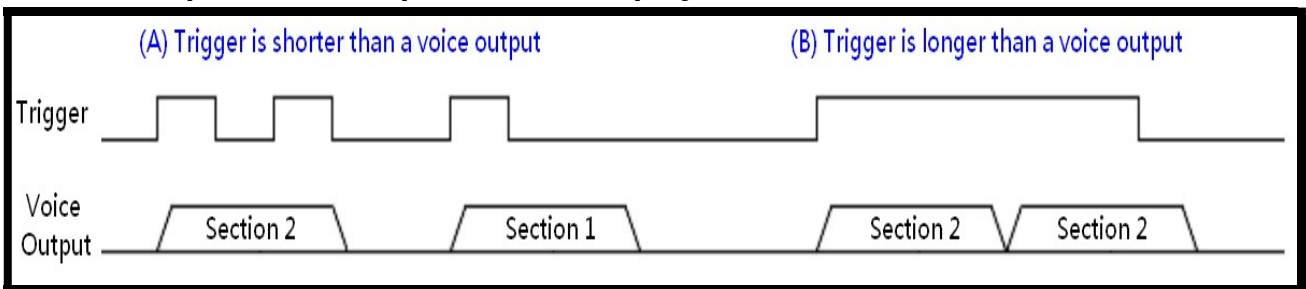
<b>Voice Section No.</b>	<b>Voice Group Contents</b>	<b>Voice Table Entries</b>
<b>Section 0</b>	<b>“How are You?”</b>	<b>File 1.</b>
<b>Section 1</b>	<b>Sound Effect + “How are You?”</b>	<b>File 2, File 1.</b>
<b>Section 2</b>	<b>“How are You?” + Music</b>	<b>File 1, File 3.</b>
<b>Section 3</b>	<b>Music</b>	<b>File 3.</b>

■ **SECTION OPIONS**

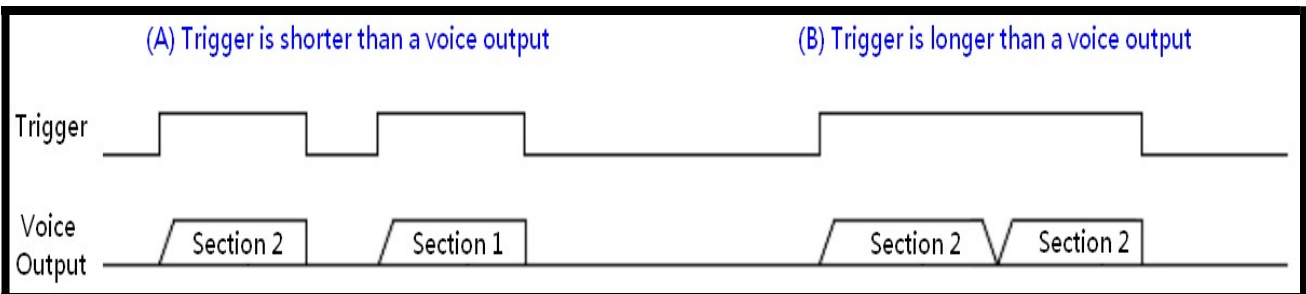
In Key, Sequential and CPU parallel mode, the software provide selectable options that affect each individual group are called “Section Options”. They are:

- **Edge or Level trigger**
- **Unholdable or Holdable trigger**
- **Re-triggerable or non-retriggerable**

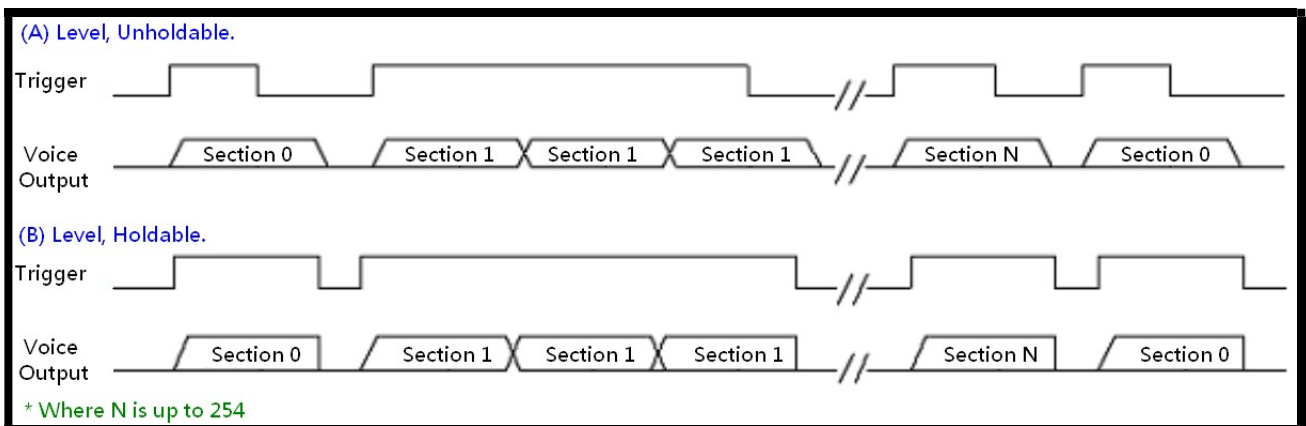
Fig. 2 to Fig. 7 show the voice playback with different combination of triggering mode and the relationship between outputs and voice playback.



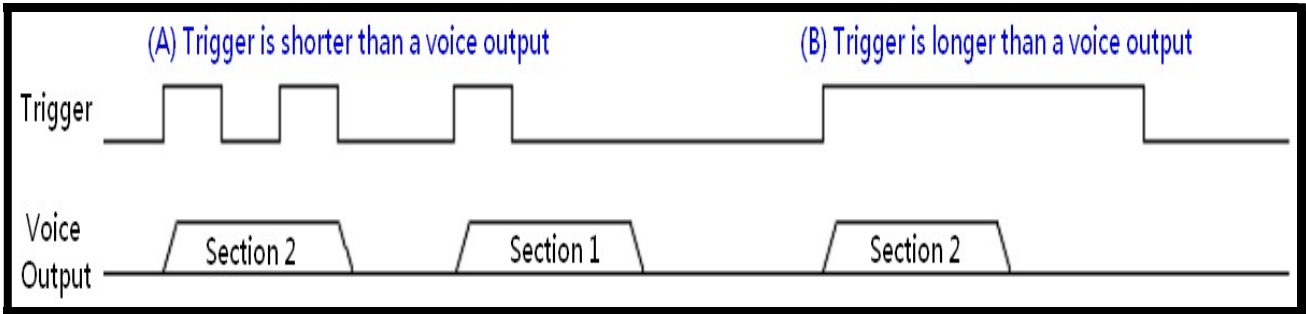
**Fig. 2 Level, Unholdable, Non-retriggerable**



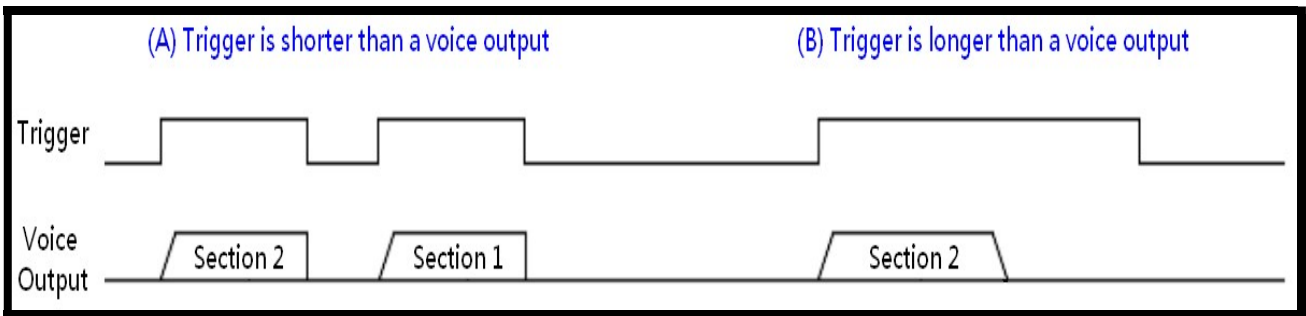
**Fig. 3 Level Holdable**



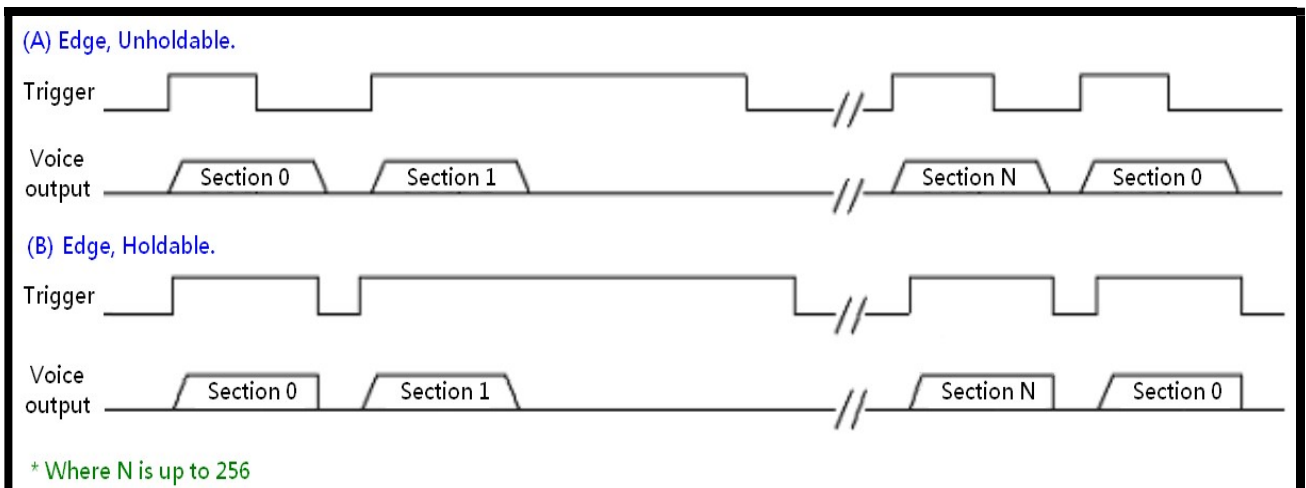
**Fig. 4 SBT sequential trigger with Level Holdable and Unholdable**



**Fig. 5 Edge, Unholdable, Non-retrigger**



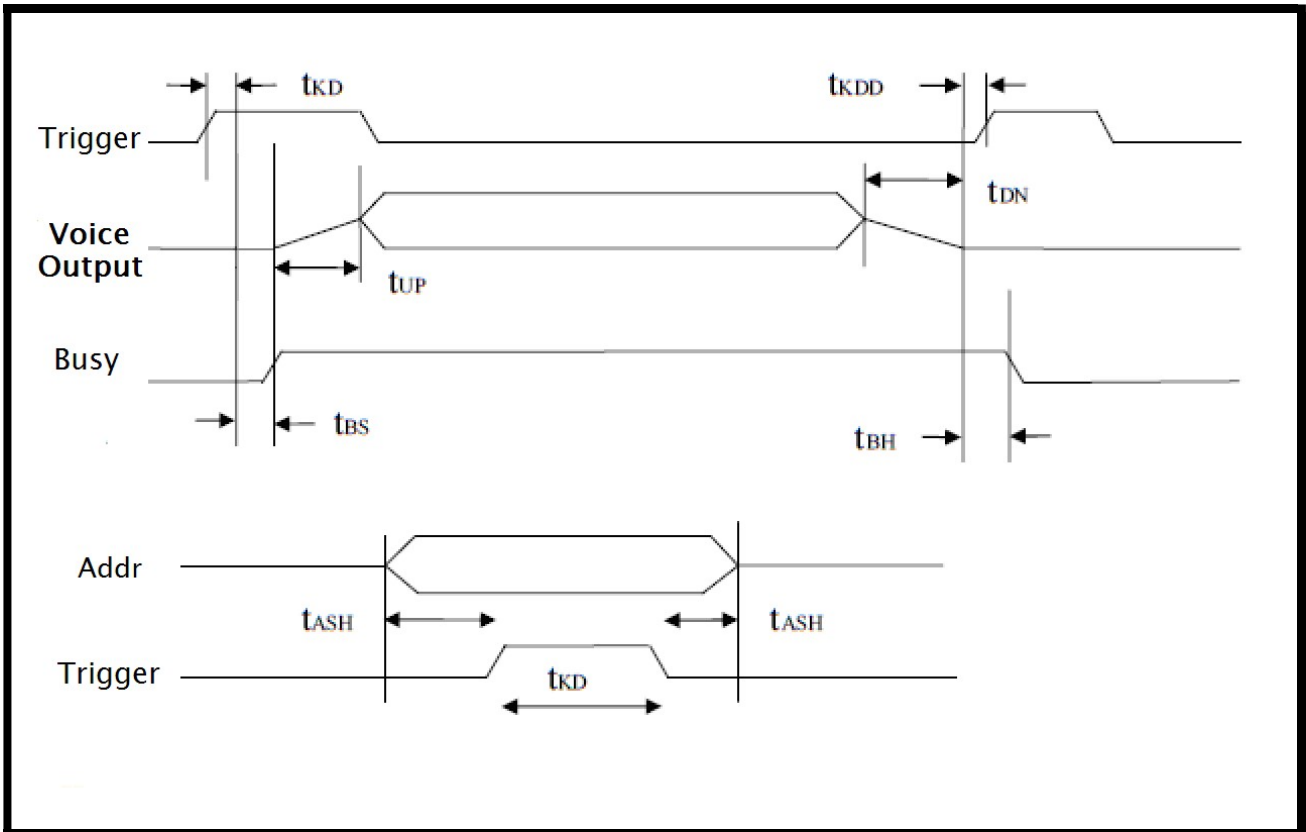
**Fig. 6 Edge, Holdable**



**Fig. 7 SBT sequential trigger with Edge Holdable and Unholdable**

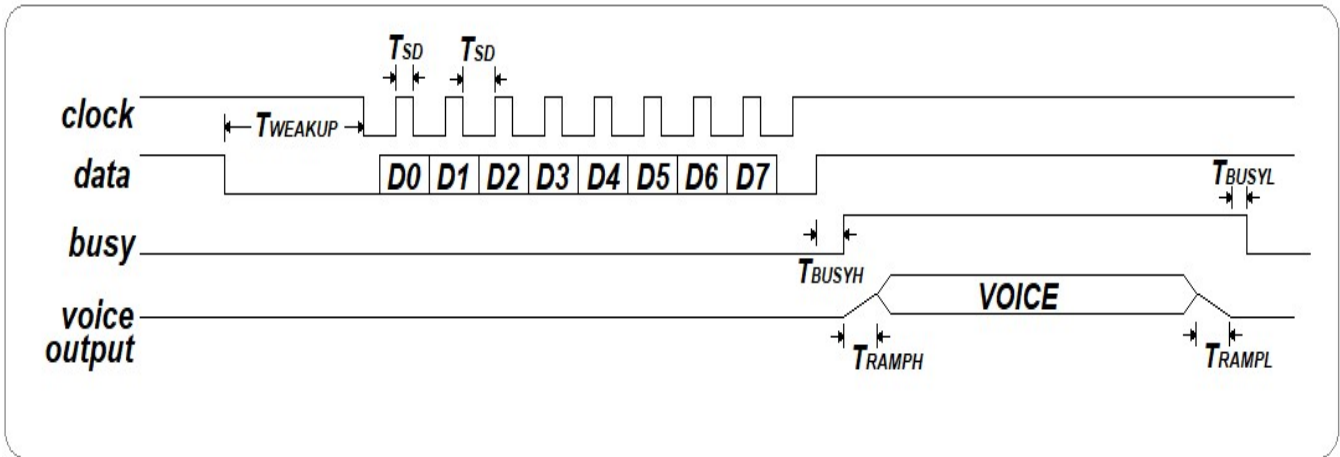


■ **TRIGGER TIMING**



**Key Trigger, Sequential, CPU Parallel and MP3 Mode**

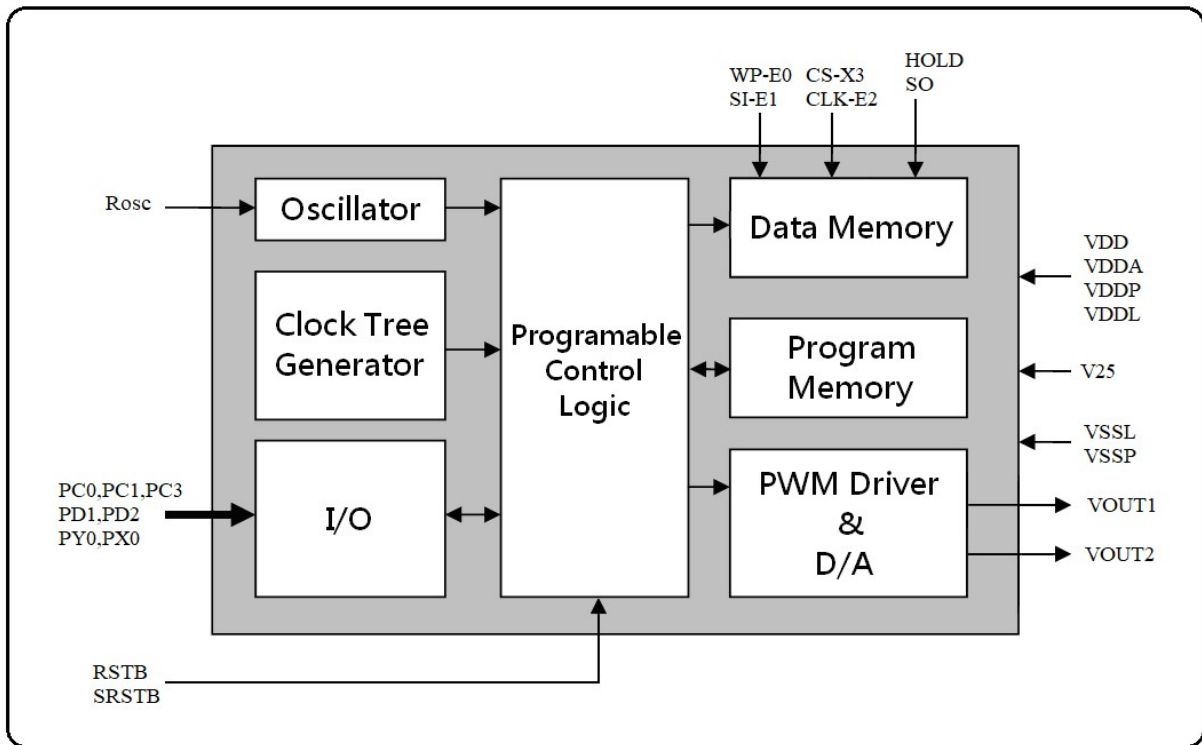
Symbol	Parameter	Min.	Typ.	Max	Unit
$t_{KD}$	Trigger debounce time	20	—	—	mS
$t_{KDD}$	Trigger delay after ramp down	—	0	—	mS
$t_{UP}$	Ramp up time	0	32	—	mS
$t_{DN}$	Ramp down time	0	—	64	mS
$t_{BS}$	BUSY output set up time	0	—	1	mS
$t_{BH}$	BUSY output set down time	0	—	1	mS
$t_{ASH}$	Address set-up / hold time	1	—	—	mS



**CPU Serial Mode**

Symbol	Parameter	Min.	Typ.	Max	Unit
$T_{WEAKUP}$	WEAK UP time		100		ms
$T_{SD}$	Serial data stay / hold time		400	—	us
$T_{RAMPH}$	Ramp up time	—	—	64	ms
$T_{RAMPL}$	Ramp down time	—	—	64	ms
$T_{BUSYH}$	BUSY output set up time	—	—	1	ms
$T_{BUSYL}$	BUSY output set down time	—	—	1	ms

■ **BLOCK DIAGRAM**



■ **ABSOLUTE MAXIMUM RATINGS**

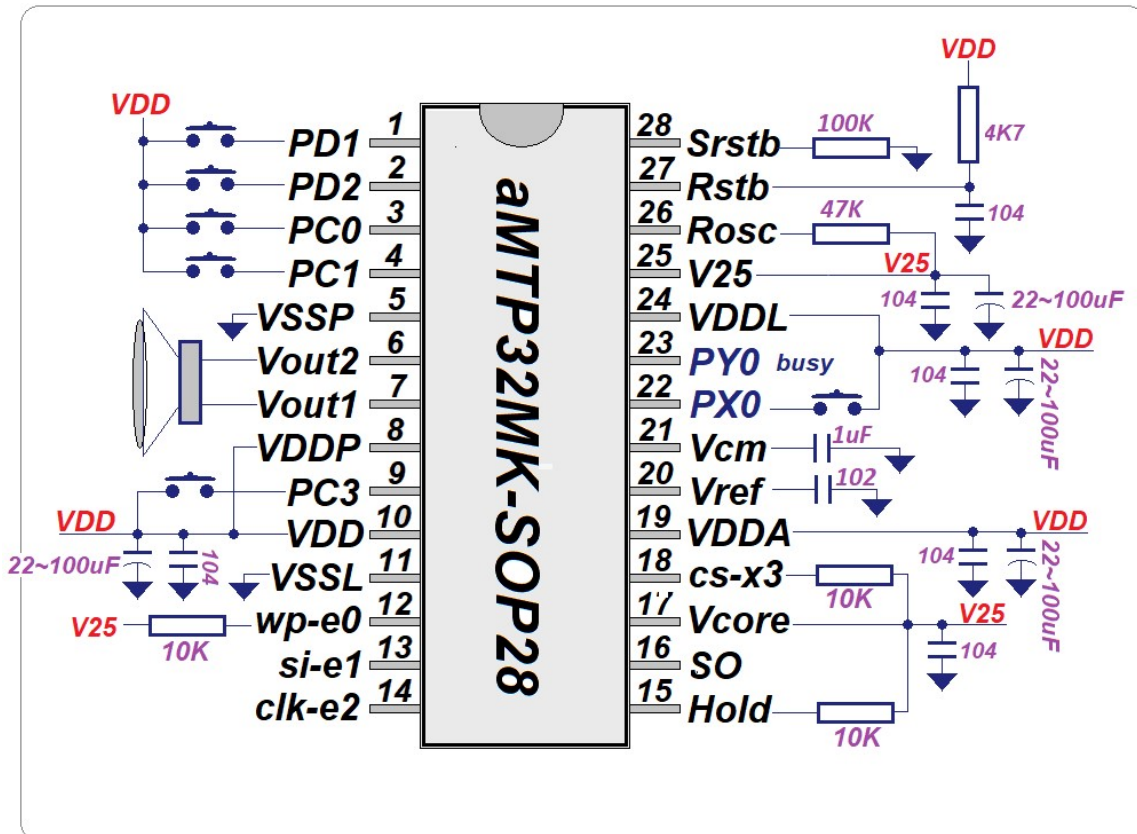
Symbol	Rating	Unit
VDD – VSS	-0.3 ~ +10.0	V
V <sub>IN</sub>	VSS-0.3 < V <sub>IN</sub> < VDD+0.3	V
V <sub>OUT</sub>	VSS < V <sub>OUT</sub> < VDD	V
T(Operating)	-40 ~ +85	°C
T(Junction)	-40 ~ +125	°C
T(Storage)	-40 ~ +125	°C

**■ DC CHARACTERISTICS**

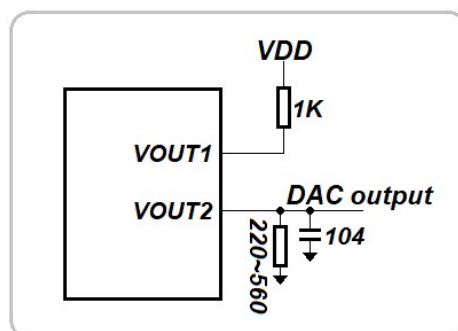
<b>Symbol</b>	<b>Parameter</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Unit</b>	<b>Conditions</b>
<b>VDD</b>	<b>Operating Voltage</b>	<b>2.7</b>		<b>6.5</b>	<b>V</b>	
<b>I<sub>SB</sub></b>	<b>Standby Current</b>			<b>1</b>	<b>μA</b>	
<b>I<sub>PDN</sub></b>	<b>Power-Down Current</b>		<b>15</b>	<b>20</b>	<b>μA</b>	
<b>I<sub>OP(IDLE)</sub></b>	<b>Operating Current (Idle)</b>		<b>20</b>		<b>mA</b>	<b>VDD = 5V</b>
<b>I<sub>OP(REC)</sub></b>	<b>Operating Current (Record)</b>		<b>35</b>		<b>mA</b>	<b>VDD = 5V</b>
<b>I<sub>OP(PLAY)</sub></b>	<b>Operating Current (Playback)</b>		<b>25</b>		<b>mA</b>	<b>VDD = 5V</b>
<b>V<sub>IH</sub></b>	<b>"H" Input Voltage</b>	<b>2.5</b>			<b>V</b>	
<b>V<sub>IL</sub></b>	<b>"L" Input Voltage</b>			<b>0.6</b>	<b>V</b>	
<b>I<sub>VOUT</sub></b>	<b>V<sub>OUT</sub> Current</b>		<b>185</b>		<b>mA</b>	
<b>I<sub>OH</sub></b>	<b>O/P High Current</b>		<b>8</b>		<b>mA</b>	<b>VDD = 5V / V<sub>OH</sub>=4.5V</b>
<b>I<sub>OL</sub></b>	<b>O/P Low Current</b>		<b>14</b>		<b>mA</b>	<b>VDD = 5V / V<sub>OH</sub>=0.5V</b>
<b>R<sub>NPIO</sub></b>	<b>Input pin pull-down resistance</b>		<b>300</b>		<b>KΩ</b>	<b>External floating or drive low.</b>
			<b>1</b>		<b>MΩ</b>	<b>External drive high.</b>
<b>R<sub>UPIO</sub></b>	<b>Input pin pull-up resistance</b>		<b>4.7</b>		<b>KΩ</b>	
<b>ΔFs/Fs</b>	<b>Frequency stability</b>			<b>5</b>	<b>%</b>	<b>VDD = 5V ± 1.0V</b>
<b>ΔFc/Fc</b>	<b>Chip to chip Frequency Variation</b>			<b>5</b>	<b>%</b>	<b>Also apply to lot to lot variation.</b>

■ **TYPICAL APPLICATIONS**

- **Key Trigger Mode**



**Key Trigger With PWM Driver Speaker**



**DAC output**

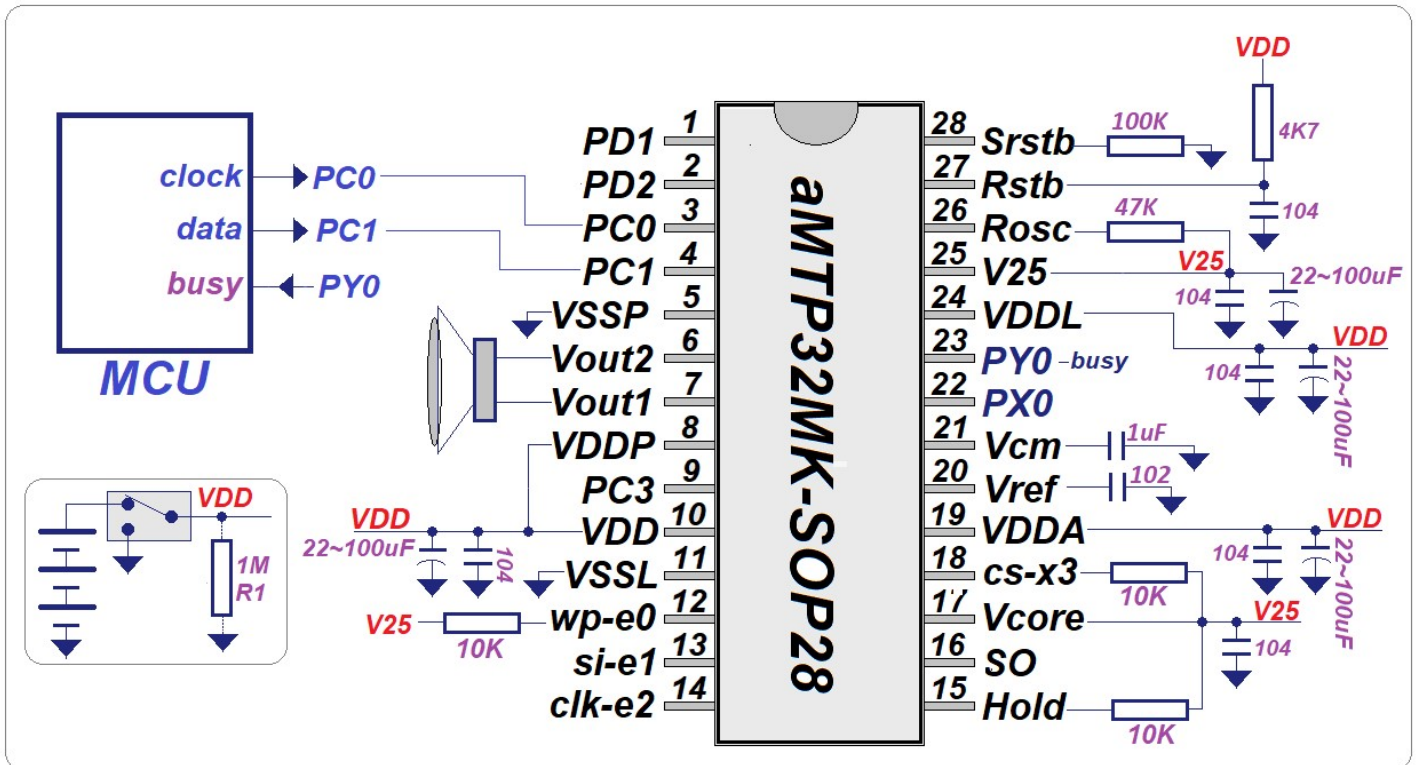








● CPU Serial Mode

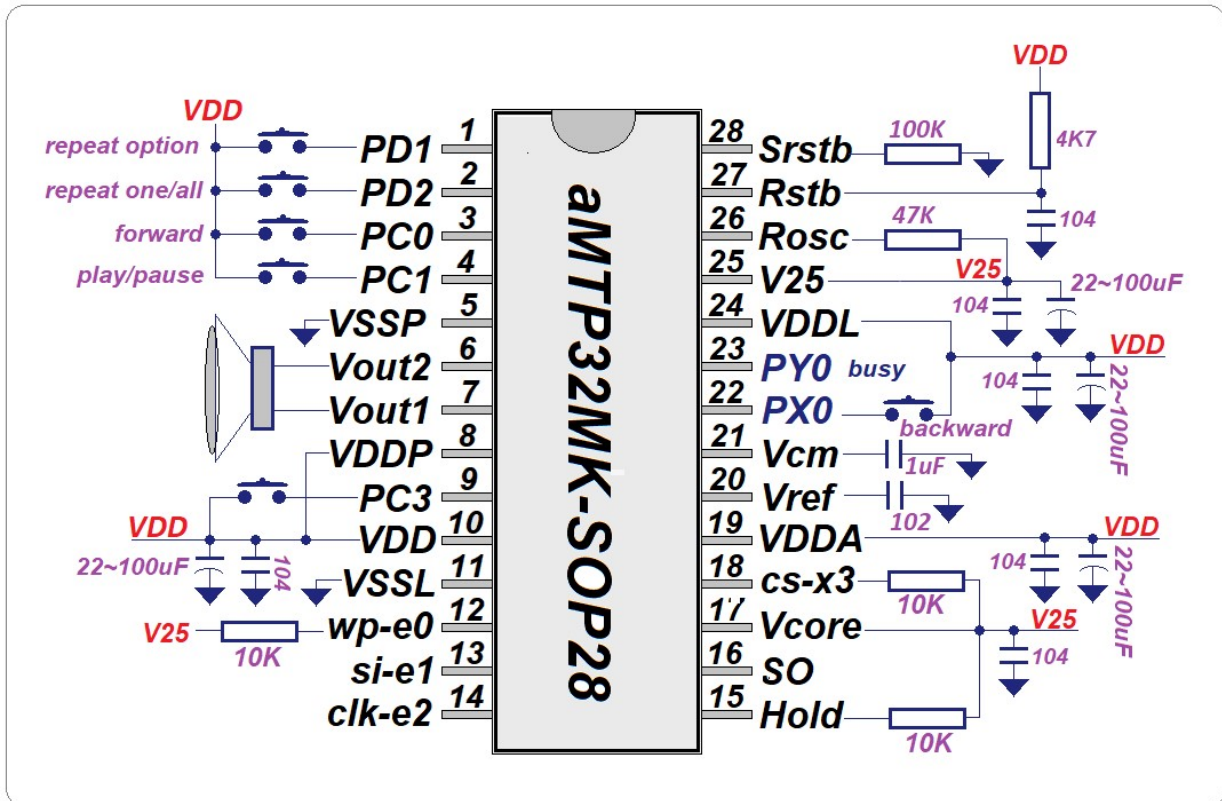


CPU Serial Trigger With PWM Driver Speaker

**Note**

1. PC0 is serial [ clock ] pin ( input ).
2. PC1 is serial [ data ] pin ( input ).
3. PY0 is busy pin ( output ).
4. R1=1M is optional for fast discharge of C=100uF when power off.

● **MP3 Mode**



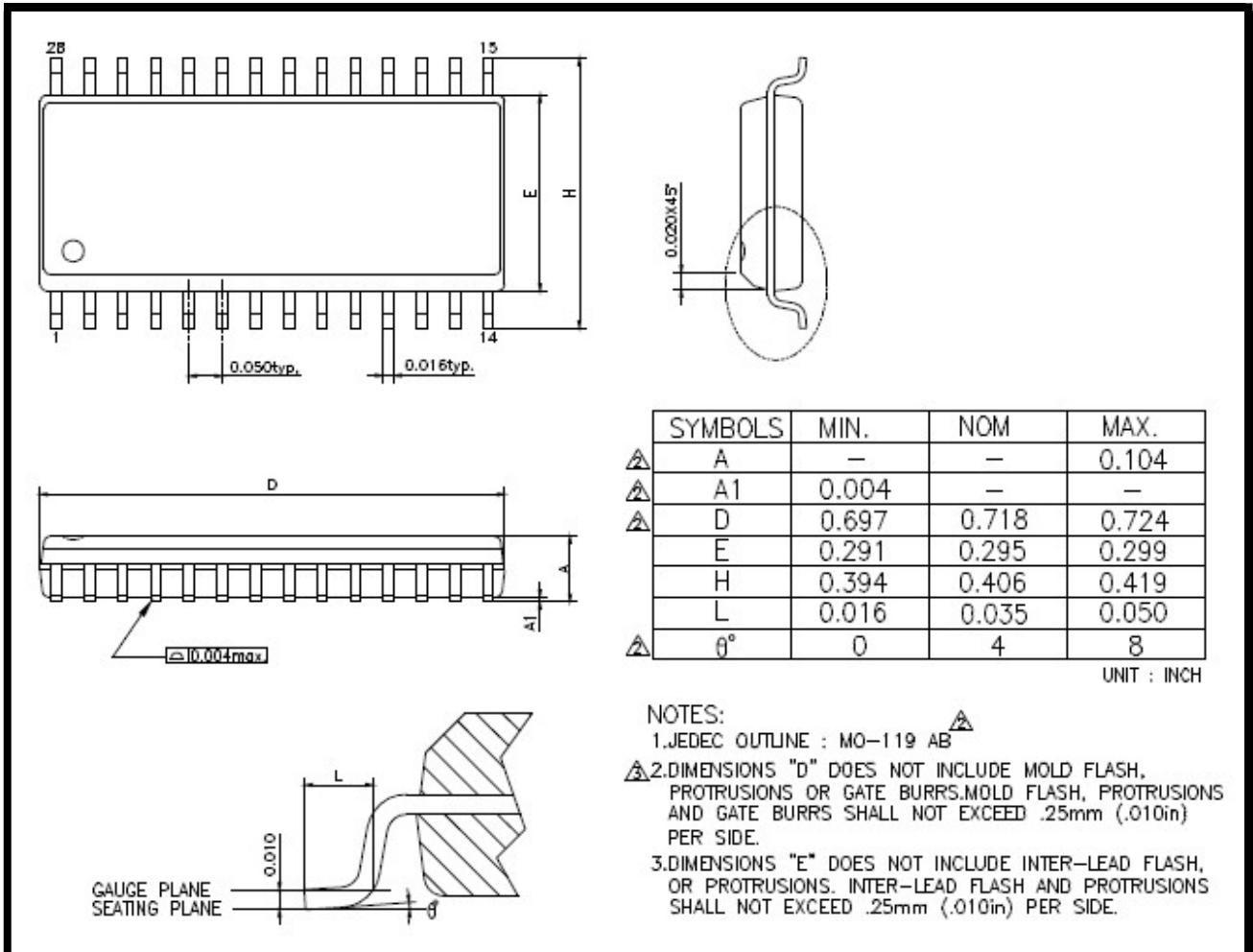
**MP3 Mode Trigger With PWM Driver Speaker**

**Note**

1. **forward** : PC0 pin ( input ).
2. **play / pause** : PC1 pin ( input ).
3. **backward** : PX0 pin ( input ).
4. **repeat enable option** : PD1 pin ( input ).
5. **repeat one/all** : PD2 pin ( input ).
6. **PD0** is busy pin ( output ).
7. **R1=1M** is optional for fast discharge of C=100uF when power off.

■ **Package Information**

- **SOP 28-PIN**



■ **HISTORY**

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Ver 1.0

2023/08/23

The 1<sup>st</sup> version datasheet for aMTP32MK.

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