

# **aFRC616**

## **Recording Controller**

### **Data sheet**

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## ■ FEATURES

- *Powerful Power Management Unit*
  - *Operating voltage range: 3.0V ~ 6.5V*
  - *All function off standby Current: 1uA (Typ.)*
  - *Support power-down mode for power saving*
  - *Build-in LDO for core and external SPI flash: 2.35V ~ 2.75V*
- *Programmable I/Os*
  - *Support 27 GPIOs*
  - *Programmable high output voltage: V<sub>CORE</sub> or V<sub>DD</sub>*
  - *2 hardware SPI interface*
- *Powerful 16-Bits Digital Audio Processor.*
  - *8bits-MCU with 16bits-DSP engine as 16-bits audio processor*
  - *Selectable PWM or DAC voice output with 16-bits resolution*
  - *Support software ADPCM and u-Law and PCM compression library*
  - *Support 6KHz ~ 48KHz sample rate*
- *Oscillator*
  - *Support internal ROOSC, external ROOSC external crystal mode*
  - *±1% deviation for internal ROOSC*
  - *±1% deviation for external ROOSC with on-system calibration procedure*
- *Memory*
  - *Build-in 12K bytes flash structure program memory with 20'000 times erase/program*
  - *Build-in 8K bytes SRAM*
  - *Support external **SPI flash** for voice data storage*
  - *Support software memory management library*
- *Single Chip, High Quality Audio/Voice Recording & Playback Solution*
  - *Minimum External Components*
- *User Friendly, Easy to Use Operation*
  - *Programming & Development Systems Not Required*
- *Nonvolatile Flash Memory Technology*
  - *No Battery Backup Required*
- *External Reset pin.*
- *Watch dog timer (WDT)*
- *High Quality Analog to Digital, DAC and PWM module*
  - *Resolution up to 16-bits*
- *Built-in Audio-Recording Microphone Amplifier*
  - *No External OPAMP or BJT Required*
  - *Software simulator AGC*

- Configurable analog interface
  - Differential-ended MIC pre-amp for Low Noise
  - High Quality Line Receiver
  
- Package :
  - LQFP44
  - SOP28
  - DICE

**Voice Duration (seconds) Table with External SPI Flash (4M~128M)**

<b>1. aFRC616 + SPI FLASH by 4 bit ADPCM</b>						
S. R. (Hz)	SPI-4M	SPI-8M	SPI-16M	SPI-32M	SPI-64M	SPI-128M
SR-24K	42"	85"	170"	341"	682"	1365"
<b>SR-12K</b>	<b>85"</b>	<b>170"</b>	<b>341"</b>	<b>682"</b>	<b>1365"</b>	<b>2730"</b>
SR-8K	128"	256"	512"	1024"	2048"	4096"
<b>2. aFRC616 + SPI FLASH by 8 bit u-low</b>						
S.R. (Hz)	SPI-4M	SPI-8M	SPI-16M	SPI-32M	SPI-64M	SPI-128M
SR-24K	21"	42"	85"	170"	341"	682"
<b>SR-12K</b>	<b>42"</b>	<b>85"</b>	<b>170"</b>	<b>341"</b>	<b>682"</b>	<b>1365"</b>
SR-8K	64"	128"	256"	512"	1024"	2048"
<b>3. aFRC616 + SPI FLASH by 16 bit PCM</b>						
S.R. (Hz)	SPI-4M	SPI-8M	SPI-16M	SPI-32M	SPI-64M	SPI-128M
SR-24K	10"	21"	42"	85"	170"	341"
<b>SR-12K</b>	<b>21"</b>	<b>42"</b>	<b>85"</b>	<b>170"</b>	<b>341"</b>	<b>682"</b>
SR-8K	32"	64"	128"	256"	512"	1024"

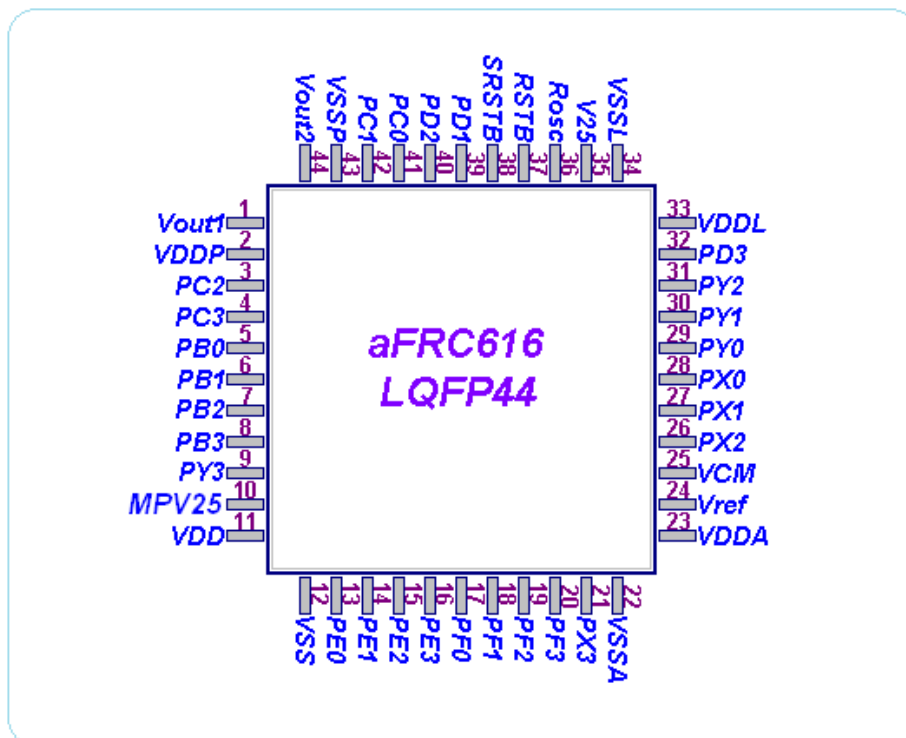
<b>Rosc</b>	47K ohm	60K	76K	95K	115K	147K	189K
<b>S.R.</b>	12K	11K	10K	9K	8K	7K	6K

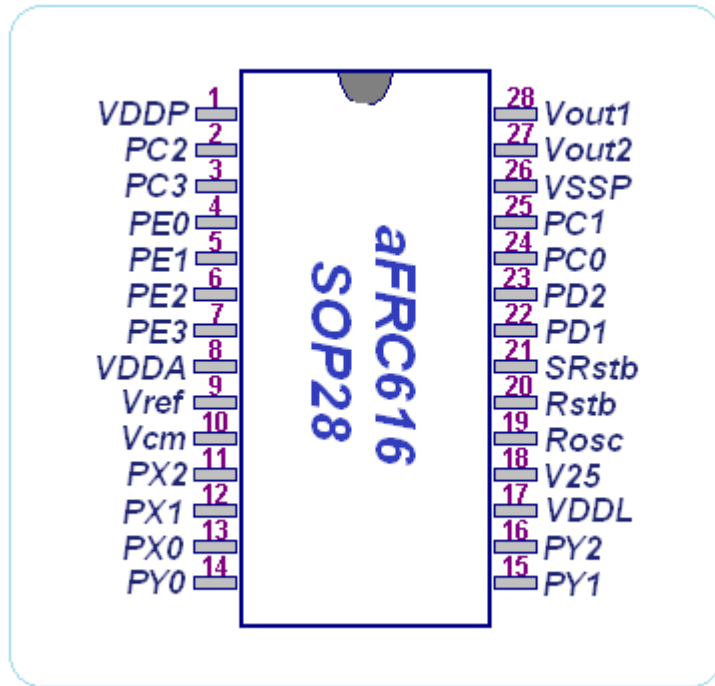
Ps : the Rosc default [ 47K ] ohm

■ **DESCRIPTION**

The aFRC616 is the powerful audio processor along with high performance audio analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). The aFRC616 is a fully integrated solution offering high performance and unparalleled integration with analog input, digital processing and analog output functionality. The aFRC616 incorporates all the functionality required to perform demanding audio/voice applications. High quality audio/voice systems with lower bill-of-material costs can be implemented with the aFRC616 because of its integrated analog data converters and full suite of quality-enhancing features such as sample-rate convertor.

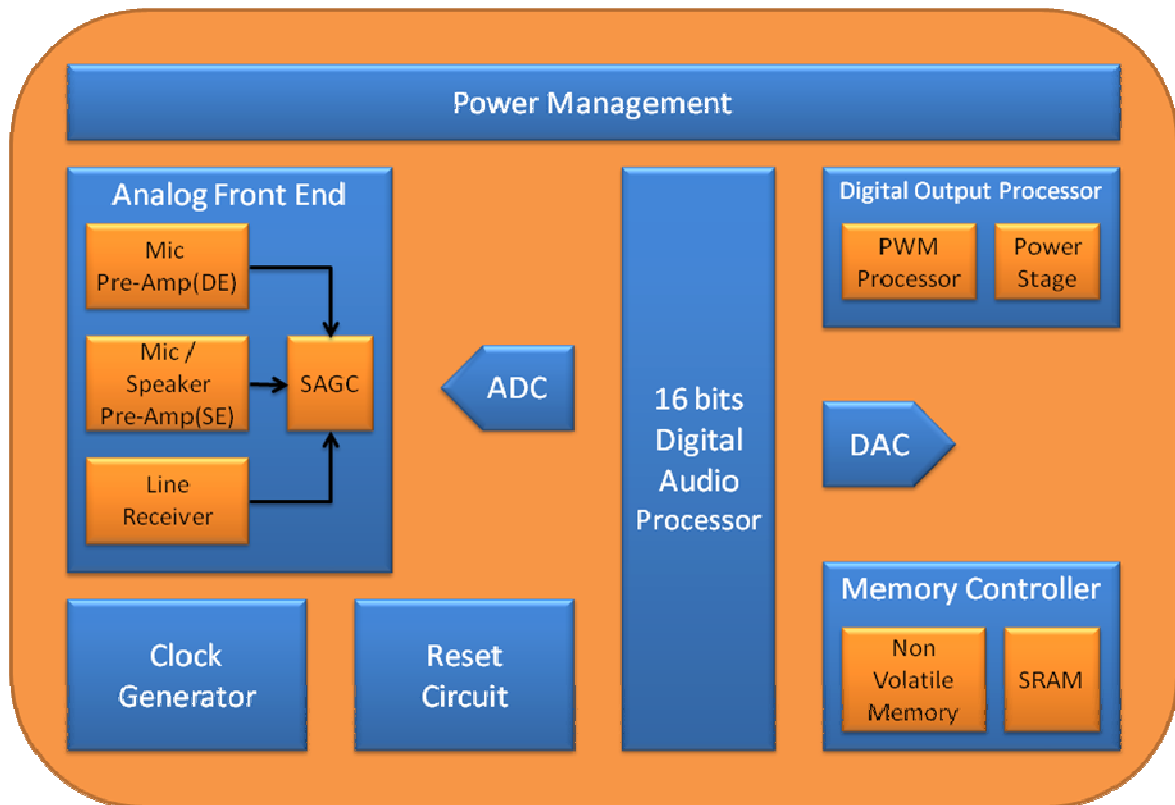
■ **PIN CONFIGURATION**





■ **BLOCK DIAGRAM**

Figure 1. Block Diagram



**■ PIN DESCRIPTION**

Pin Names	Pin No		TYPE	Description
	LQFP44	SOP28		
VDDP	2	1		Positive power supply for Internal PWM block.
VDD	11	X		Positive power supply for GPIOs.
VDDA	23	8		Positive power supply for Internal analog block.
VDDL	33	17		Positive power supply for Internal LDO.
VSSA	22	26		Power ground for Internal PWM block.
VSSL	34	26		Power ground for Internal LDO.
VSSP	43	26		Power ground for Internal analog block.
VSS	12	26		Power ground.
V25	35	18		Internal LDO output for core logical
MPV25	10	X		Internal LDO output for SRAM & external SPI flash.
VREF	24	9		Reference voltage for Internal LDO and analog block.
VCM	25	10		Common mode voltage
RSTB	37	20	IN	Chip reset, low active.
SRSTB	38	21	IN	System reset, only use in program (Engineering) mode, pull-down a resistor to the VSSL.
VOUT1	1	28	OUT	GPIO or PWM output to drive speaker directly.
VOUT2 /COUT	44	27	OUT	GPIO, PWM output to drive speaker directly or DAC output.
PC0/TCLK	41	24	I/O	GPIO or system program interface.
PC1/TDAT	42	25		
PC2	3	2	I/O	GPIO.
PC3	4	3		
PD0/ROSC	36	19	I/O	GPIO or external oscillate resistor.
PD1/OSCI	39	22	I/O	GPIO or external crystal.
PD2/OSCO	40	23	I/O	

Pin Names	Pin No		TYPE	Description
	LQFP44	SOP28		
<b>PD3</b>	32	X	I/O	GPIO
<b>PB0</b>	5	X	I/O	GPIO
<b>PB1</b>	6	X	I/O	GPIO
<b>PB2</b>	7	X	I/O	GPIO
<b>PB3</b>	8	X	I/O	GPIO
<b>PE0</b>	13	4	I/O	SOP28 : CS pin of SPI FLASH LQFP44 : GPIO
<b>PE1</b>	14	5	I/O	SOP28 --- DIO pin of SPI FLASH LQFP44--- DIO pin of SPI FLASH
<b>PE2</b>	15	6	I/O	SOP28--- SCK pin of SPI FLASH LQFP44--- SCK pin of SPI FLASH
<b>PE3</b>	16	7	I/O	SOP28 --- DO pin of SPI FLASH LQFP44 --- GPIO
<b>PF0</b>	17	X	I/O	LQFP44 --- GPIO
<b>PF1</b>	18	X	I/O	GPIO
<b>PF2</b>	19	X	I/O	GPIO
<b>PF3</b>	20	X	I/O	LQFP44--- DO pin of SPI FLASH
<b>PX0</b>	28	13	IN	[ Mic- ] --- Microphone differential input.
<b>PX1</b>	27	12	I/O	GPIO
<b>PX2</b>	26	11	I/O	GPIO
<b>PX3</b>	21	X	I/O	LQFP44--- /CS pin of SPI FLASH
<b>PY0</b>	29	14	IN	[ Mic+ ] ---Microphone differential input.
<b>PY1</b>	30	15	OUT	MICG --- Microphone ground
<b>PY2</b>	31	16	I/O	GPIO
<b>PY3</b>	9	X	I/O	GPIO

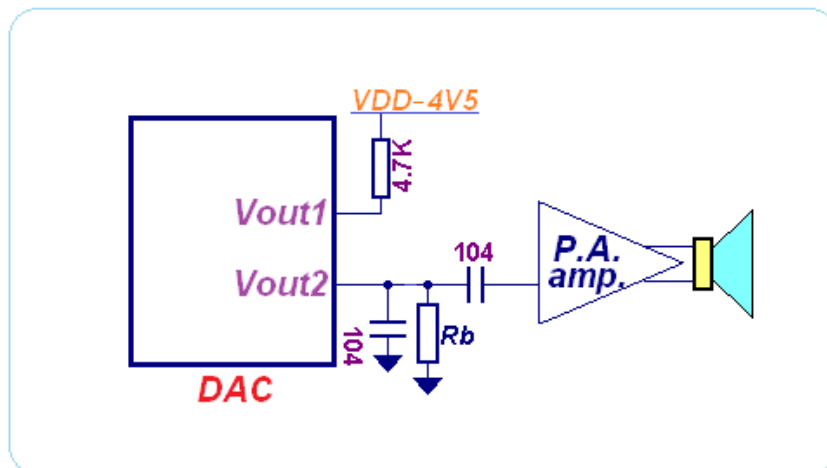
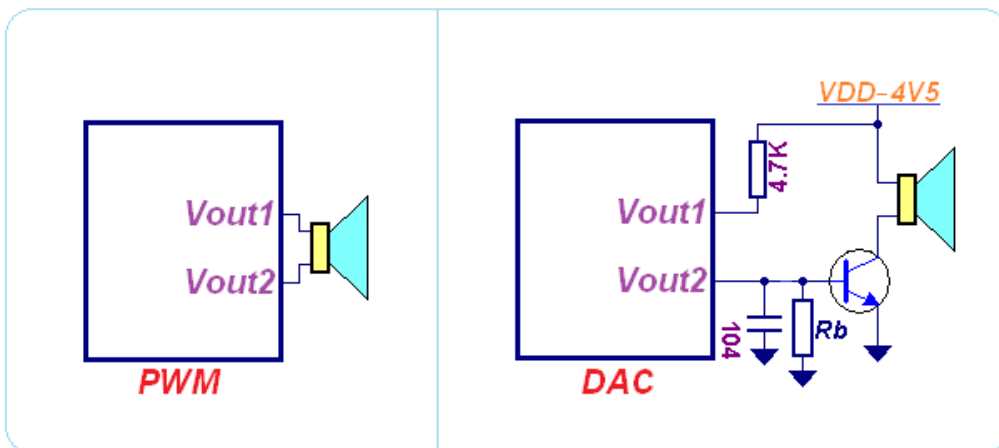
■ **VOICE OUTPUT**

The aFRC616 series support 2 voice output modes, PWM and DAC.

The PWM mode use VOUT1 and VOUT2 pin to drive speaker directly without external components to save cost.

The DAC mode use VOUT2 pin to output current signal. User can use the signal to drive audio amplifier or mix with other components in their applications to provide larger voice volume.

The following fig. show circuit for different output methods: PWM, DAC, DAC with transistor.





■ **RESET**

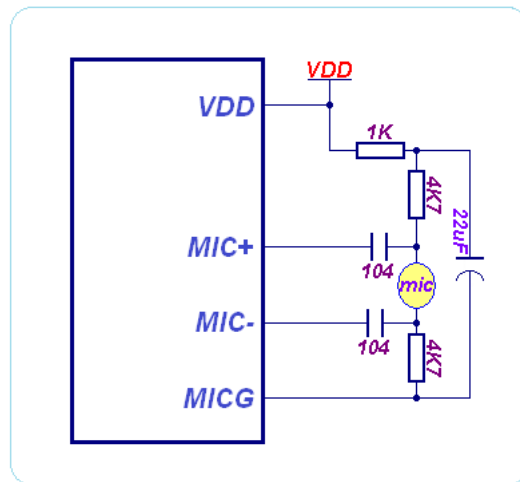
The aFRC616 can enter standby mode when RSTB pin drive to low. During chip in the standby mode, the current consumption is reduced to  $I_{SB}$  and any operation will be stopped, user also can not execute any new operate in this mode.

The standby mode will continue until RSTB pin goes to high, chip will be started to initial, and playback “beep” tone to indicate enter idle mode.

User can get less current consumption by control RSTB pin especially in some application which concern standby current.

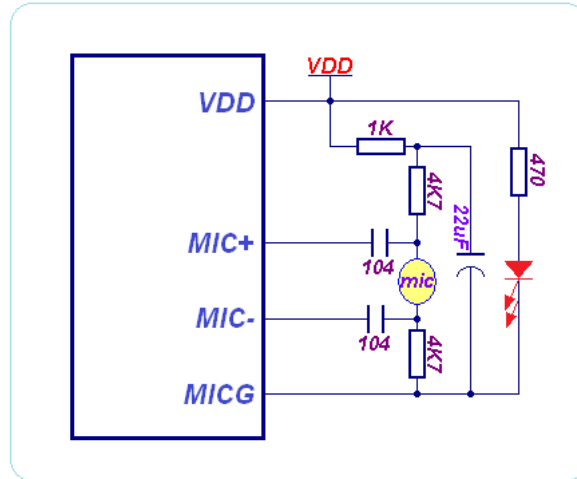
■ **BUSY**

The MICG pin will be drove to low during the message record or playback, and drove to high during idle or standby, user can detect MICG status to know chip is busy or not.



Please note it is limited for MICG pin driving current. Reference to IOH and IOL in section “DC CHARACTERISTICS”. If MICG pin is over loading from external circuit, it will cause noise in microphone circuit.

*Below is a typical application. We add one LED to indicate IC record and playback status. We use one Resistor to limit current. And suggest  $R > 470\Omega$*



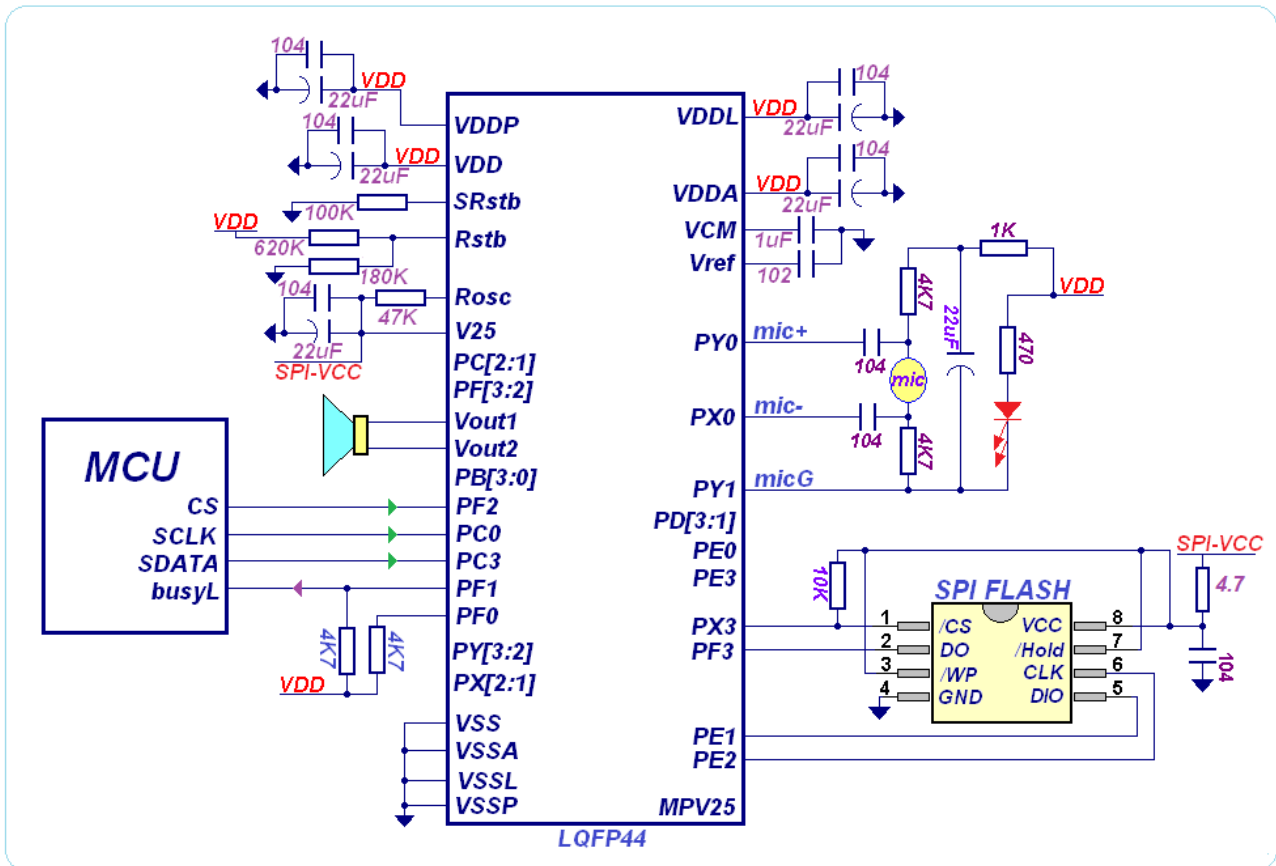
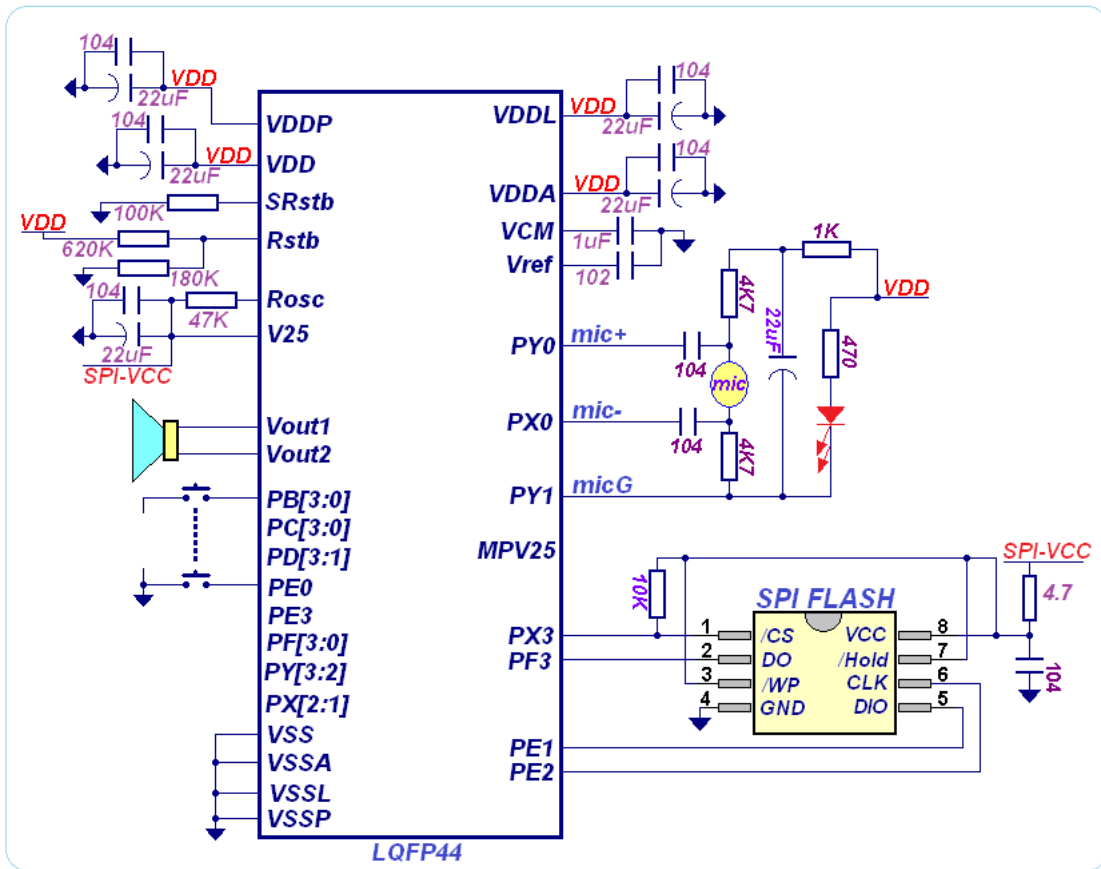
### ■ ABSOLUTE MAXIMUM RATINGS

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

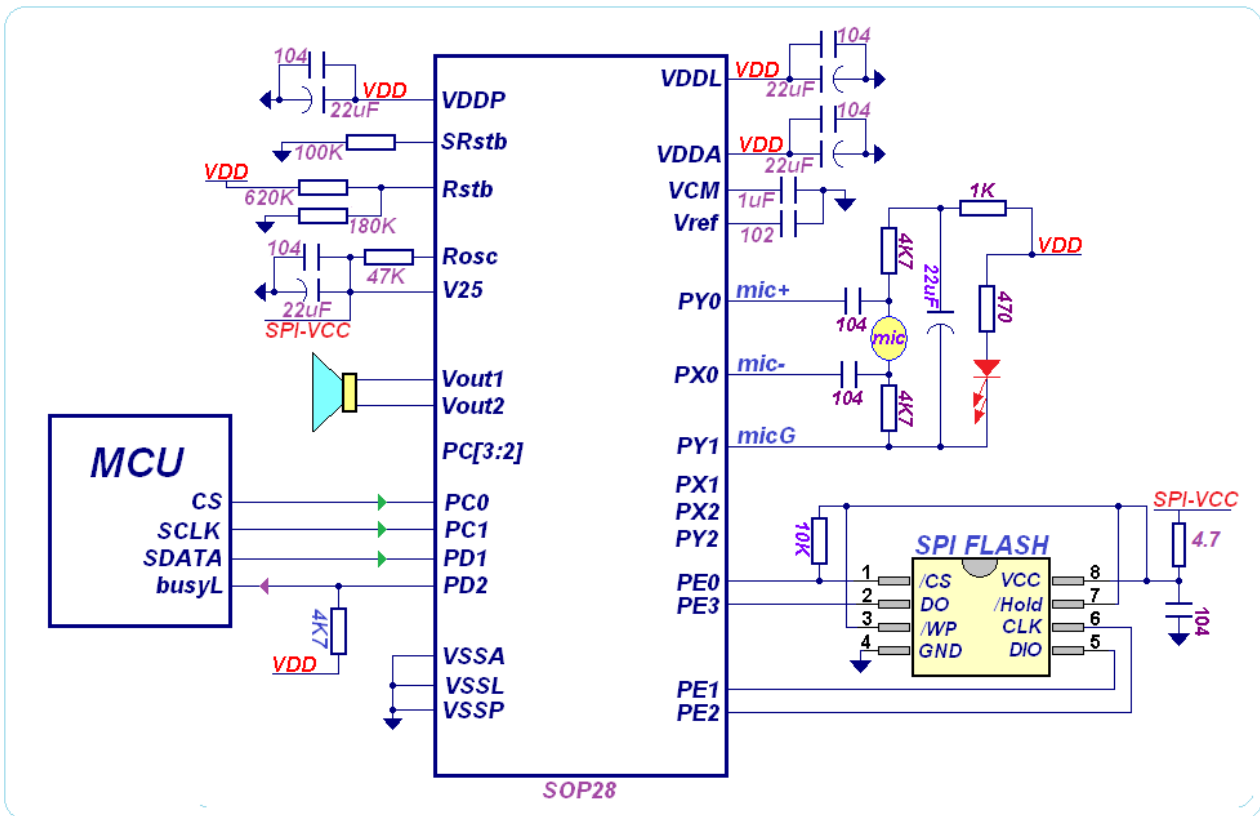
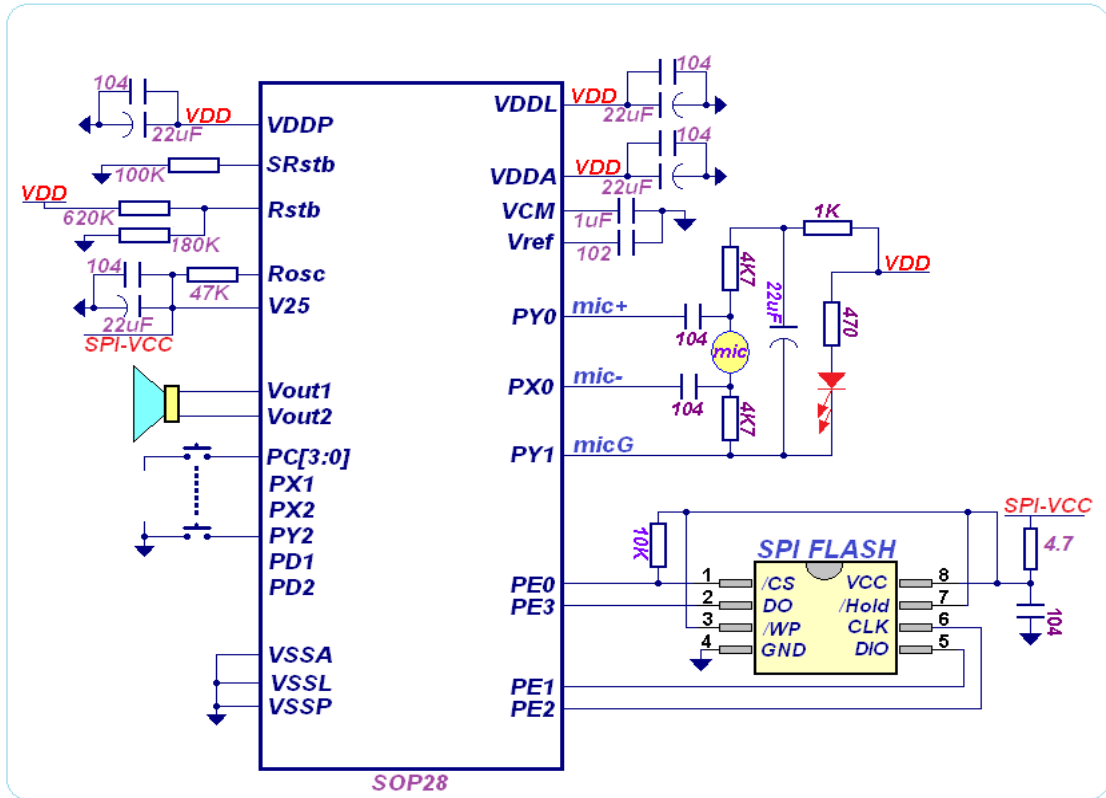
## ■ DC CHARACTERISTICS

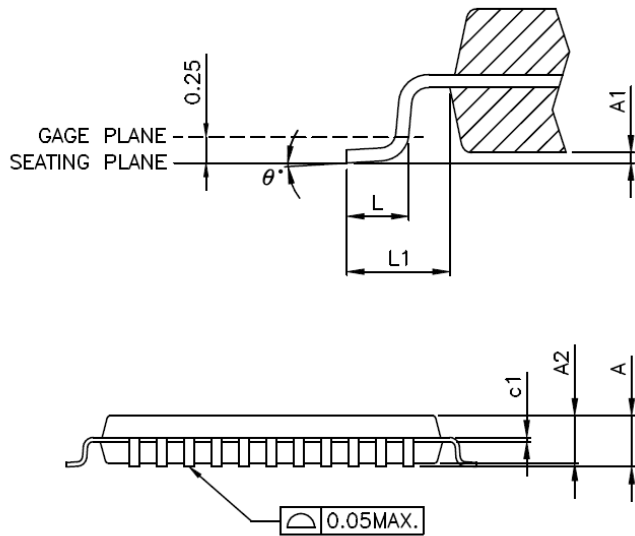
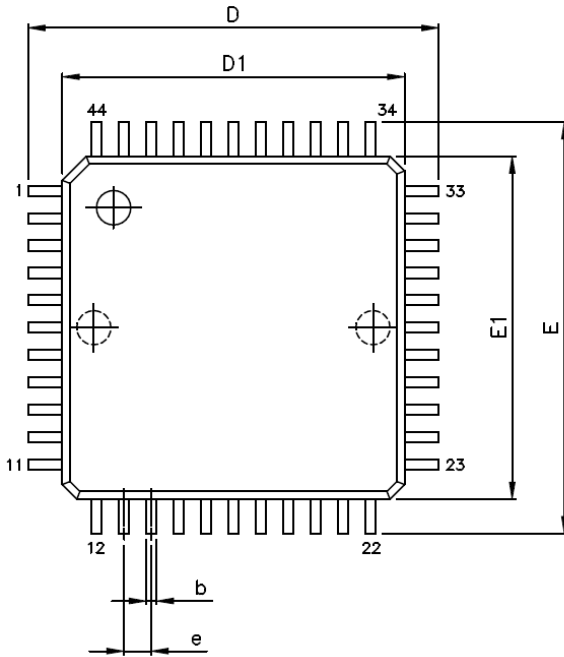
Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
$V_{DD}$	Operating Voltage	3.0		6.5	V	
$V_{LDO}$	Internal LDO Output Voltage	2.35		2.75	V	
$V_{REF}$	Reference Voltage	1.20		1.30	V	
$I_{SB}$	Standby Current		1		$\mu A$	All function off
$I_{PDN}$	Power-Down Current		15	20	$\mu A$	
$I_{OP(IDLE)}$	Operating Current (Idle)		20		mA	$V_{DD} = 5V$
$I_{OP(REC)}$	Operating Current (Record)		35		mA	$V_{DD} = 5V$
$I_{OP(PLAY)}$	Operating Current (Playback)		25		mA	$V_{DD} = 5V$
$V_{IH}$	"H" Input Voltage	2.5			V	
$V_{IL}$	"L" Input Voltage			0.6	V	
$I_{VOUT}$	VOUT Current		185		mA	
$I_{OH}$	O/P High Current		8		mA	$V_{DD} = 5V / V_{OH} = 4.5V$
$I_{OL}$	O/P Low Current		14		mA	$V_{DD} = 5V / V_{OH} = 0.5V$
$R_{NPIO}$	Input pin pull-down resistance		300		$K\Omega$	External floating or drive low.
			1		$M\Omega$	External drive high.
$R_{UPIO}$	Input pin pull-up resistance		4.7		$K\Omega$	
$\Delta F_s/F_s$	Frequency stability			1.5	%	$V_{DD} = 5V \pm 1.0V$
$\Delta F_c/F_c$	Chip to chip Frequency Variation			1.0	%	Also apply to lot to lot variation.

■ APPLICATION CIRCUIT : for LQFP44



- For SOP28 :



**■ PACKAGE INFORMATION :**
**• LQFP44 Package :**


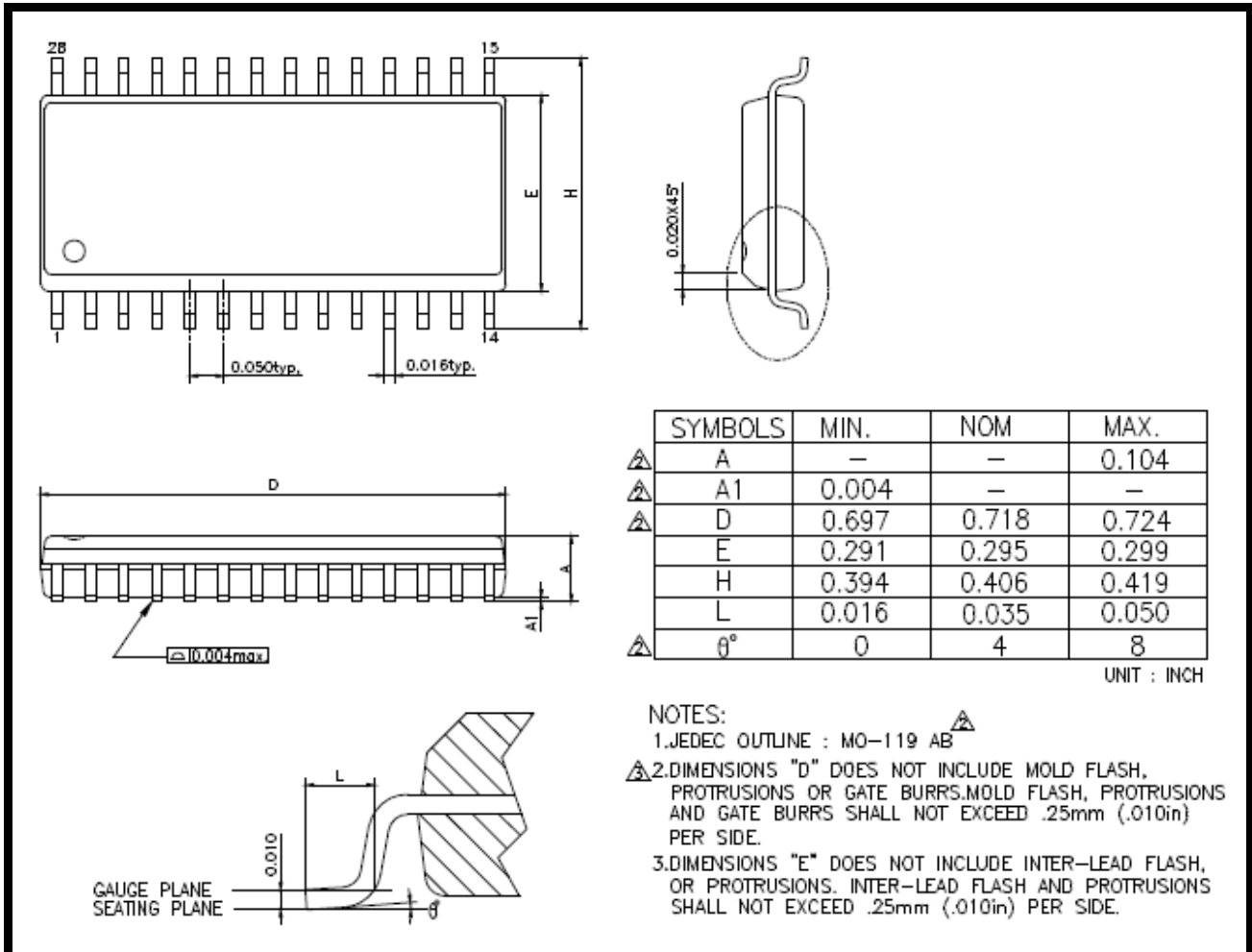
VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
c1	0.09	—	0.16
D	12.00 BSC		
D1	10.00 BSC		
E	12.00 BSC		
E1	10.00 BSC		
e	0.80 BSC		
$\Delta$ b (w/o plating)	0.25	0.30	0.35
L	0.45	0.60	0.75
L1	1.00 REF		
$\theta^\circ$	0°	3.5°	7°

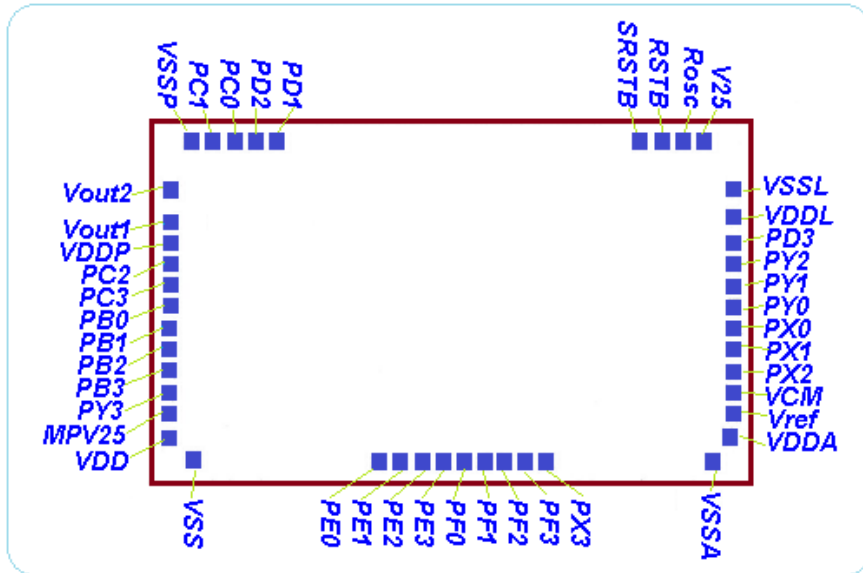
**NOTES:**

1. JEDEC OUTLINE: MS-026 BCB
2. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PER SIDE. D1 AND E1 ARE MAXIMUM PLASTIC BODY SIZE DIMENSIONS INCLUDING MOLD MISMATCH.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED THE MAXIMUM b DIMENSION BY MORE THAN 0.08mm.

- 28Pin 300mil SOP Package :



● **BONDING PAD DIAGRAMS :**





■ **HISTORY**

**Ver. 1.0 (2016/07/01)**

- Original version data sheet for aFRC616.