

PWM/PFM Dual Mode Step-down DC/DC Converter

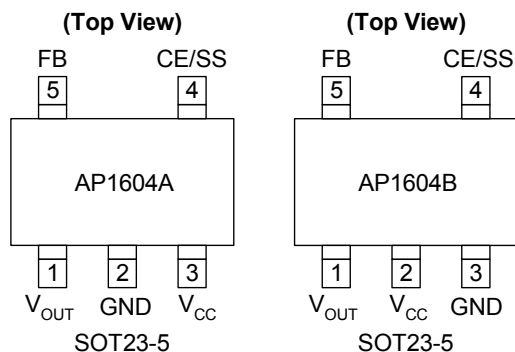
■ Features

- Input voltage range: 2.2V~6V (V_{OUT} type)
- Oscillator frequency: 600kHz (Typ.)
- High Efficiency: 93% (typ.)
- Stand-by capability: $I_{STB}=5\mu A$. (max.)
- Soft-start time set-up externally type possible
- Current limit and thermal shutdown protection
- **Pb-Free** Package: SOT23-5

■ Applications

- Electronic Information Organizers
- Palmtops
- Cellular and portable phones
- Portable Audio Systems
- Various Multi-function Power Supplies

■ Pin Assignment



■ General Descriptions

The AP1604 series are multi-functional step-down DC/DC converters with built-in speed, low ON resistance drivers. A more than 1A output current is possible using an externally coil, diode and capacitor.

Output voltage is set-up by external resistor. ($\pm 2.5\%$ accuracy) .

With a 600kHz switching frequency, the size of the external components can be reduced.

Control switches from to PFM during light loads with the AP1604 (PWM/PFM switchable) and the series is highly efficient from light loads to large output currents.

In relation to soft-start time external capacitor regulated types.

During stand-by time (CE/SS pin "LOW") ,current consumption is reduced to less than $5\mu A$.

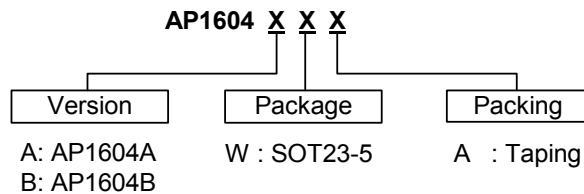
Will be forcibly switched off if used below the stipulated voltage.

■ Pin Descriptions

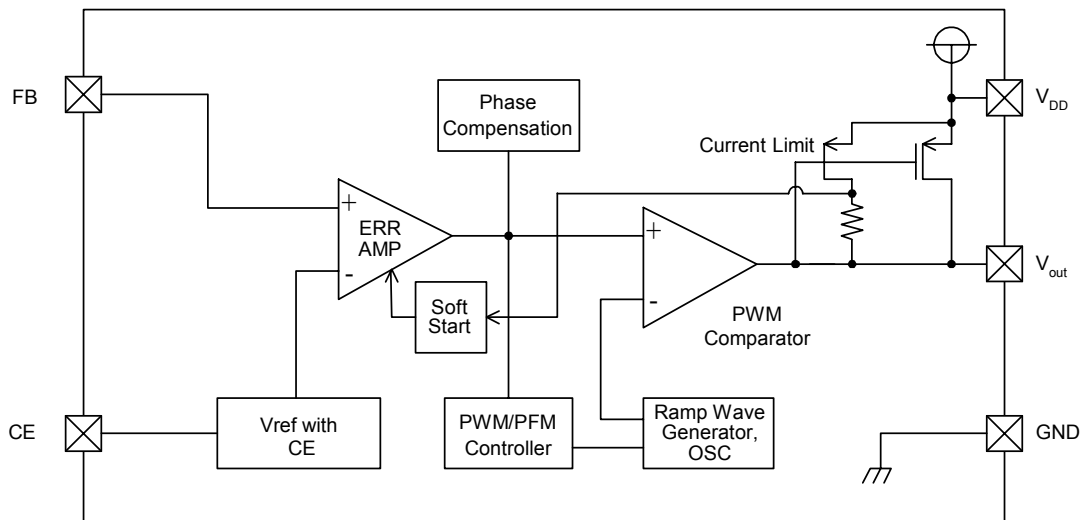
PIN NAME	FUNCTION
V_{OUT}	Output Voltage
V_{CC}	Input Supply
GND	Ground
CE/SS	Chip Enable / Soft Start
FB	Feedback pin

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■ Ordering Information



■ Block Diagrams



■ Absolute Maximum Ratings

$T_a=25^{\circ}\text{C}$

SYMBOL	PARAMETER	RATINGS	UNITS
V_{CC}	V_{IN} Pin Voltage	-0.3 ~ 6.5	V
V_{OUT}	V_{OUT} Pin Voltage	-0.3 ~ $V_{IN}+0.3$	V
V_{FB}	FB Pin Voltage	-0.3 ~ $V_{IN}+0.3$	V
$V_{CE/SS}$	CE/SS Pin Voltage	-0.3 ~ $V_{IN}+0.3$	V
P_d	Continuous Total Power Dissipation	Internal limited	
T_{opr}	Operating Ambient Temperature	-25 ~ +80	$^{\circ}\text{C}$
T_{stg}	Storage Temperature	-40 ~ +125	$^{\circ}\text{C}$

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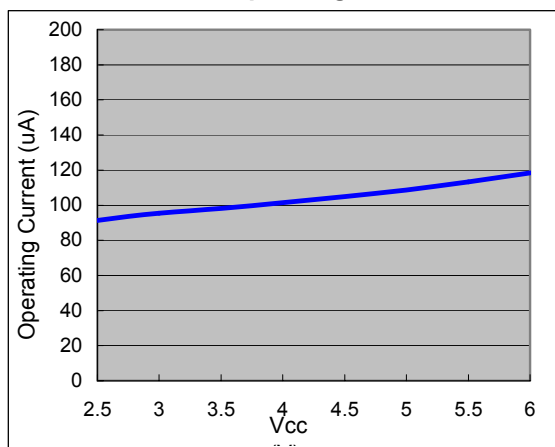
■ Electrical Characteristics

$V_{IN}=5V$, $V_{OUT}=2V$, Load=300mA, $T_a=25^\circ C$

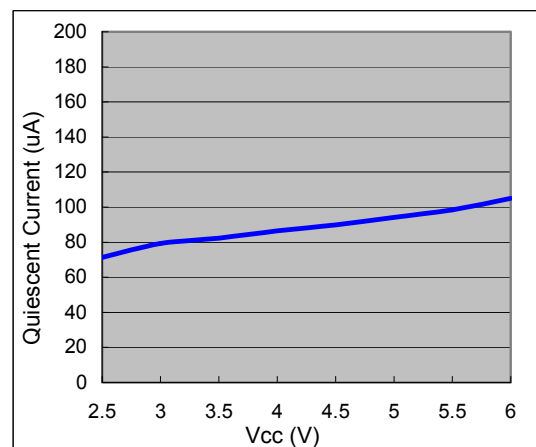
Sym.	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{FB}	FB		0.975	1.0	1.025	V
V_{IN}	Input Voltage		2.2	-	6	V
	Line Regulation	$V_{IN}=2.2\sim 6V$, Load=10mA	-	-	0.12	%
	Load Regulation	$I_{OUT}=10\sim 800mA$	-	-	1.2	%
V_{UVLO}	UVLO Voltage (min. operating voltage)	V_{CC} , voltage required to maintain H at V_{OUT}	-	-	2	V
I_{CC}	Operating Current	CE/SS= V_{IN} , No Load	-	100	150	μA
I_{CCQ}	Supply Current	No external components, CE/SS= V_{IN} , $V_{FB}=0V$	-	90	120	μA
I_{STB}	Stand-by Current	No external components, CE/SS=0V, $V_{FB}=0V$	-	-	5	μA
I_{CL}	current limit	peak current $V_{IN}=5V$, $V_{OUT}=2V$	800	1000	1200	mA
Fosc	Oscillator Frequency	Load=300mA, $V_{IN}=5V$, $V_{OUT}=2V$	500	600	700	kHz
MAXDTY	Maximum Duty Ratio		85	90	-	%
PFMDTY	PFM Duty Ratio	NO load	15	25	35	%
V_{CEH}	CE/SS "High" Voltage	Apply 1.4V (min.) to CE/SS, determine V_{OUT} "High"	1.4	-	-	V
V_{CEL}	CE/SS "Low" Voltage	Same as V_{CEH} , determine V_{OUT} "Low"	-	-	0.6	V
EFFI	Efficiency	$V_{CC}=5V$, $V_{OUT}=3.3V$, Load=300mA	-	93	-	%
Rdson	Rdson condition	$I_{OUT}=300mA$, $V_{IN}=5V$, $V_{OUT}=2V$	-	350	450	m Ω

■ Typical Performance Characteristics

Vcc v.s. Operating Current



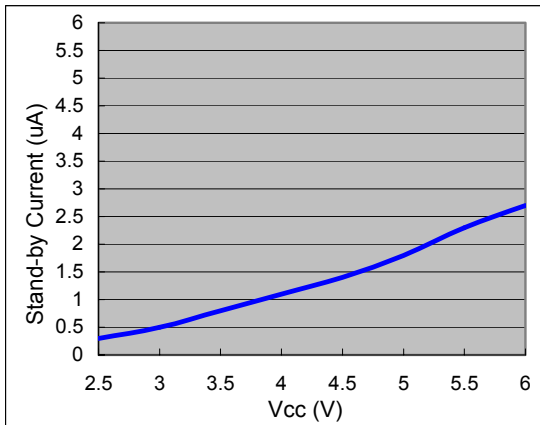
Vcc v.s. Quiescent Current



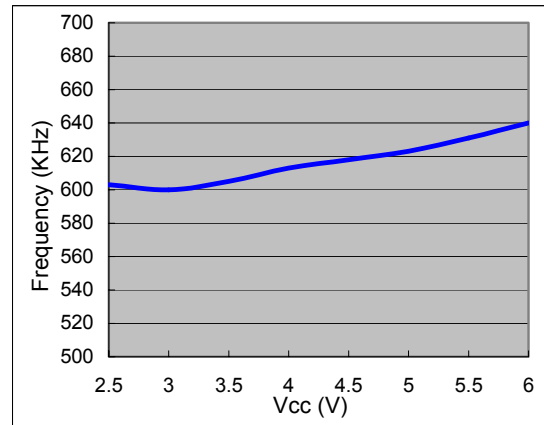
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■ Typical Performance Characteristics (Continued)

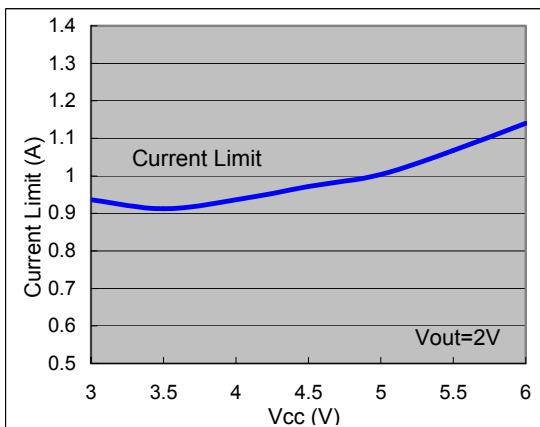
Vcc v.s. Stand-by Current



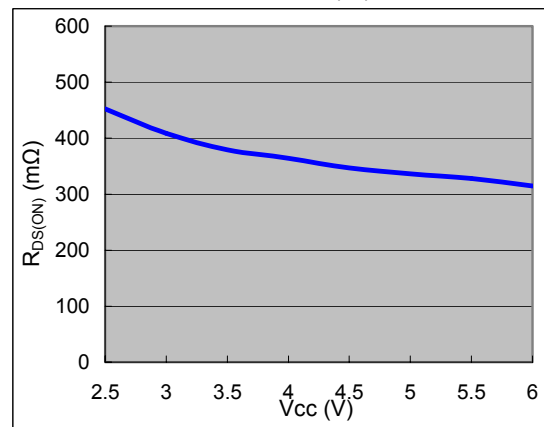
Vcc v.s. Frequency



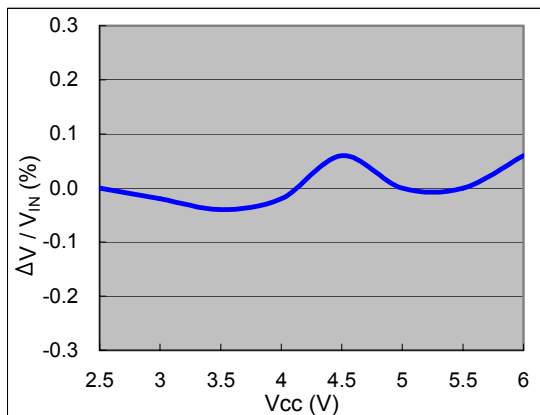
Vcc v.s. Current Limit



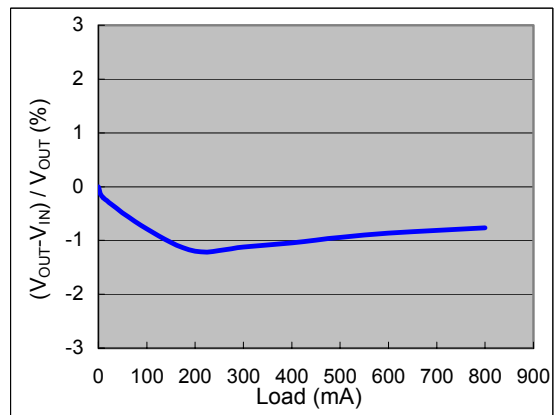
Vcc v.s. R_{DS(ON)}



Line Regulation

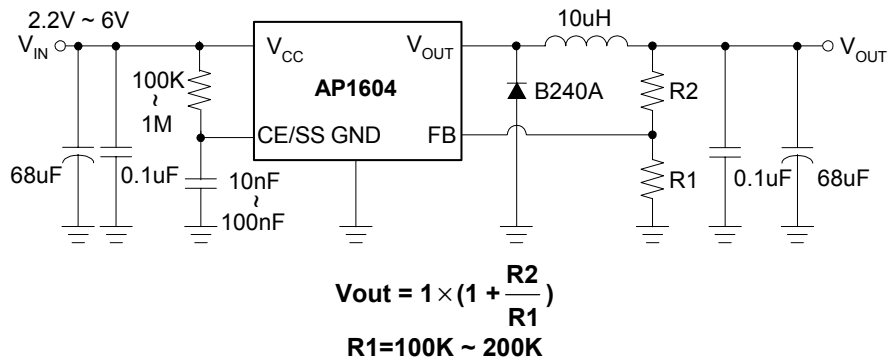


Load Regulation



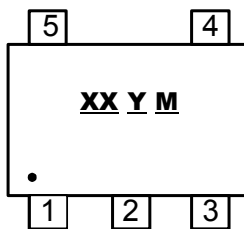
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■ Typical Application Circuit



■ Marking Information

SOT23-5L



XX : Identification code
(See Appendix)

Y : Year: 0-9

M : Month: A~L

SOT23-5L

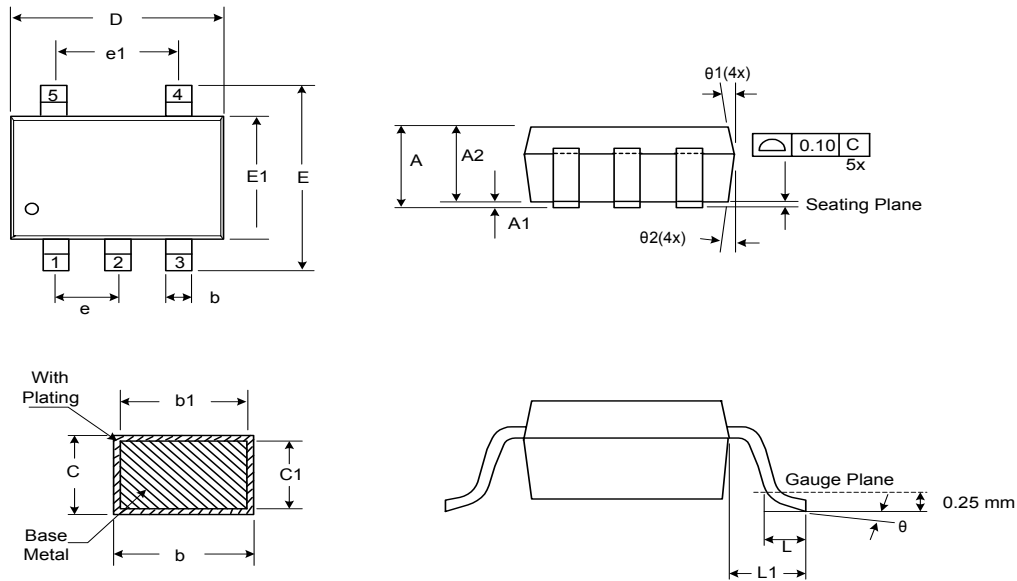
Appendix

Part Number	Package	Identification Code
AP1604A	SOT23-5	ER
AP1604B	SOT23-5	ES

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■ Package Information

Package Type: SOT23-5L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	1.20	1.35	0.041	0.047	0.053
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.25	-	0.55	0.010	-	0.022
b1	0.25	0.40	0.45	0.010	0.016	0.018
c	0.08	-	0.20	0.003	-	0.008
c1	0.08	0.11	0.15	0.003	0.004	0.006
D	2.70	2.85	3.00	0.106	0.112	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
L	0.35	0.45	0.55	0.014	0.018	0.022
L1	0.60 Ref.			0.024 Ref.		
e	0.95 Bsc.			0.037 Bsc.		
e1	1.90 Bsc.			0.075 Bsc.		
θ	0°	5°	10°	0°	5°	10°
$\theta 1$	3°	5°	7°	3°	5°	7°
$\theta 2$	6°	8°	10°	6°	8°	10°