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## Features

- 300 mA/1.9V/2.5V DC to DC Converter
- 80 mA/2.8V Dual-mode LDO Regulator (LDO1)
- 130 mA/2.7V/2.8V LDO Regulator (LDO2)
- 130 mA/2.8V LDO Regulator (LDO3)
- 130 mA/2.8V LDO Regulator (LDO4)
- 10 mA/1.8/2.8V Dual-mode LDO Regulator (LDO5)
- Available in a 5 mm x 5 mm 32-pin QFN or 5 mm x 5 mm 32-ball BGA Package
- Applications: Mobile Phones, Digital Cameras, PDAs, SmartPhones, DECT Phones, Handset Devices

## Description

The AT73C212 provides a power management solution for integration of multimedia features in mid-level mobile phone handsets. These features may include a camera module (CMOS or CCD), audio generators for a polyphonic or MP3 ringer, a co-processor for JPEG encoding and an external memory module.

The AT73C212 contains six power supplies: five linear voltage regulators providing output voltage from 1.8V to 2.8V and output current from 10 mA to 130 mA and a DC - DC converter supplying 300 mA from 1.9V or 2.5V.

The device is available in two compact, space-saving package options: 32-ball BGA or 32-pin QFN.



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## Power Management for Mobiles (PM)

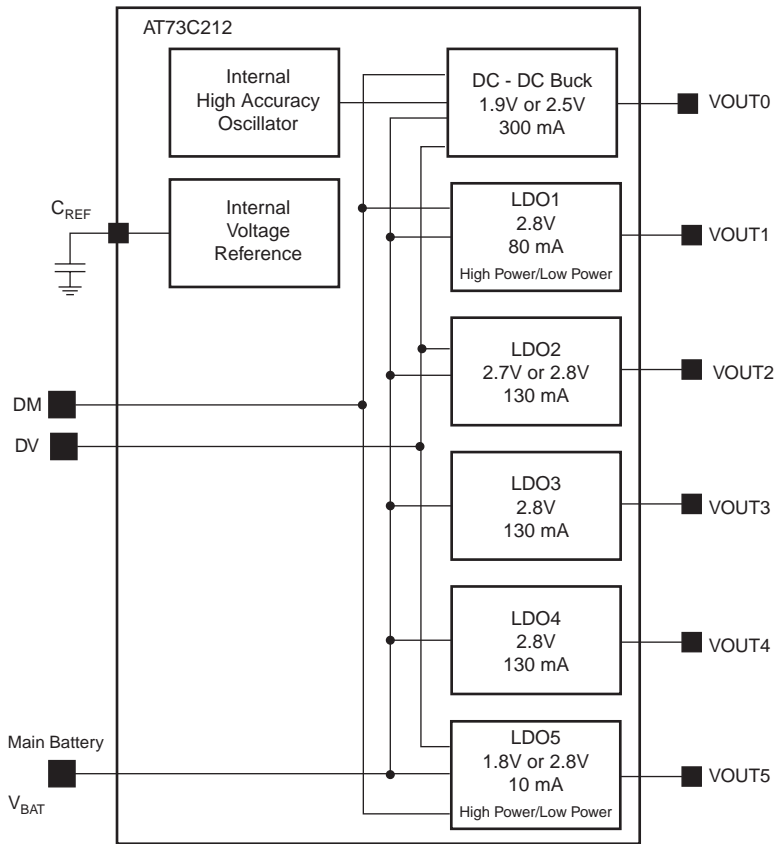
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### AT73C212



# Block Diagram

Figure 1. AT73C212 Block Diagram



## Absolute Maximum Ratings

Storage Temperature .....	-55°C to +150°C	<p><b>*NOTICE:</b> Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.</p>
Operating Temperature .....	-40°C to +85°C	
Power Supply Input .....	-0.3V to 5.5V	
IO Input (all except power supply) .....	-0.3 to 2.8V	

## Pin List

Table 1. Pin List

Ball	Signal	Type	Description
A1	VOUT4	O	LDO4 output voltage
A2	GNDB	Ground	LDO3 and LDO4 ground
A3	VINC	Supply	LDO3 and LDO4 input supply
A4	GNDD	Ground	Digital ground
A5	VINB	Supply	LDO1 and LDO2 input supply
A6	VINT	O	Decoupling capacitor for internal voltage supply
A7	GNDE	Ground	LDO1 and LDO2 ground
B1	VOUT3	O	LDO3 output voltage
B2	EN3	I	Enable LDO3
B3			Not connected
B4	VOUT2	O	LDO2 output voltage
B5	EN2	I	Enable LDO2
B6	VOUT1	O	LDO1 output voltage
B7			Not connected
C1	GNDF	Ground	Analog ground
C2			Not connected
C3	GNDG	Ground	Analog ground
C4	EN4	I	Enable LDO4
C5	GNDH	Ground	Analog ground
C6	GNDI	Ground	Analog ground
C7	CAP	O	Decoupling capacitor for voltage reference
D1	GNDC	Ground	LDO5 ground
D2			Not connected
D3			Not connected
D4	DV	I	Programmable Voltage Selection
D5	ON	I	Switch on PMU
D6			Not connected
D7	VIND	Supply	LDO5 input supply
E1	VINE	Supply	Battery voltage
E2			Not connected
E3			Not connected
E4			Not connected
E5	GNDL	Ground	Analog ground
E6	EN5	I	Enable LDO5

**Table 1.** Pin List

Ball	Signal	Type	Description
E7	VOUT5	O	LDO5 output voltage
F1			Not connected
F2			Not connected
F3			Not connected
F4			Not connected
F5			Not connected
F6	Reset	O	PMU start up OK
F7	LX	I	Inductor connection
G1			Not connected
G2			Not connected
G3			Not connected
G4	VOUT0	O	DCDC output voltage
G5	DM	I	Dual power selection
G6	VINA	Supply	DCDC input supply
G7	GND A	Ground	DCDC ground

## DC to DC Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.  $C_{OUT} = 22\mu\text{F}$  - Tantalum -  $L_{OUT} = 10\mu\text{H}$

**Table 2.** DC to DC Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage	PWM Mode (DM = 0, DV = 0) Overall accuracy	1.80	1.90	2.0	V
$V_{OUT}$	Output Voltage	Initial Voltage after Trimming		$1.9 \pm 2\%$		V
$V_{OUT}$	Output Voltage	PWM Mode (DV = 1, DM = 0)	2.45	2.50	2.55	V
$I_{OUT}$	Output Current	PWM Mode (DM = 0)		150	300	mA
$I_{SD}$	Shut Down Current			0.1	1	$\mu\text{A}$
Eff	Efficiency	$I_{OUT} = 10\text{ mA}$ to $200\text{ mA}$ @ $1.9\text{V}$	85	90		%
$\Delta V_{DCLD}$	Static Load Regulation	DC - DC Mode (10% to 90% of $I_{OUT}$ max) DM = 0		7		mV
$\Delta V_{TRLD}$	Transient Load Regulation	DC - DC Mode (10% to 90% of $I_{OUT}$ max) $T_R = T_F = 5\text{ us}$ ; DM = 0		30		mV
$\Delta V_{DCLE}$	Static Line Regulation	DC - DC Mode (10% to 90% of $I_{OUT}$ max, 3.2V to 4.2V) DM = 0		20		mV
$\Delta V_{TRLE}$	Transient Line Regulation	DC - DC Mode (10% to 90% of $I_{OUT}$ max, 3.2V to 4.2V) DM = 0		35		mV
$V_{OUT}$	Output Voltage	LDO Mode (DV = 0, DM = 1)	1.75	1.80	1.85	V
$V_{OUT}$	Output Voltage	LDO Mode (DV = 1, DM = 1)	2.35	2.40	2.45	V
$I_{OUT}$	Output Current	LDO Mode (DM = 1)			10	mA
$V_{DROP}$	Dropout Voltage	LDO Mode (DM = 1)			400	mV
$I_{QC}$	Quiescent Current	LDO Mode (DM = 1)		11	14	$\mu\text{A}$
$\Delta V_{DCLD}$	Static Load Regulation	LDO Mode (0 to 10 mA); DM = 1			50	mV
$\Delta V_{TRLD}$	Transient Load Regulation	LDO Mode (0 to 10 mA), $T_R = T_F = 5\text{ }\mu\text{s}$ , DM = 1			10	mV
$\Delta V_{DCLE}$	Static Line Regulation	LDO Mode (3.2V to 4.2V); DM = 1			8	mV
$\Delta V_{TRLE}$	Transient Line Regulation	LDO Mode (3.2V to 4.2V); DM = 1			15	mV
PSRR	Ripple Rejection	LDO Mode up to 1KHz; DM = 1	40	45		dB
$\Delta V_{LPFP}$	Overshoot Voltage	Voltage drop from LDO (LP) to DC - DC (FP)		0	10	mV
$\Delta V_{FPLP}$	Undershoot Voltage	Voltage drop from DC - DC (FP) to LDO (LP)	- 15	0		mV

**Table 3.** DC to DC External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		17	22	26	$\mu\text{F}$
$C_{ESR}$	Output Capacitor ESR				100	mOhm
$L_{OUT}$	Output Inductor Value		8	10	12	$\mu\text{H}$
$L_{ESR}$	Output Inductor ESR	At 100 kHz			1.1	Ohm



## LDO1 Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.

**Table 4.** LDO1 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage Full Power Mode	DM = 0	2.7	2.8	2.9	V
$V_{OUT}$	Output Voltage Low Power Mode	DM = 1	2.7	2.8	2.9	V
$I_{OUT}$	Output Current Full Power Mode	DM = 0		50	80	mA
$I_{OUT}$	Output Current Low Power Mode	DM = 1			10	mA
$I_{QC}$	Quiescent Current FP Mode	DM = 0	25	30	36	$\mu\text{A}$
$I_{QC}$	Quiescent Current LP Mode	DM = 1	9	11	13	$\mu\text{A}$
$\Delta V_{OUT}$	Line Regulation FP Mode	$V_{BAT}: 3.4\text{V}$ to $3\text{V}$ , $I_{OUT} = 80\text{ mA}$ , DM = 0			1	mV
$\Delta V_{PEAK}$	Line Regulation Transient FP Mode	$V_{BAT}: \text{From } 5\text{V}$ to $5.4\text{V}$ and from $3.4\text{V}$ to $3\text{V}$ , $I_{OUT} = 80\text{ mA}$ , $T_R = T_F = 5\ \mu\text{s}$ , DM = 0			2.7	mV
$\Delta V_{OUT}$	Line Regulation LP Mode	$V_{BAT}: 3.4\text{V}$ to $3\text{V}$ , $I_{OUT} = 5\text{ mA}$ , DM = 1			2	mV
$\Delta V_{PEAK}$	Line Regulation Transient LP Mode	$V_{BAT}: \text{From } 5\text{V}$ to $5.4\text{V}$ and from $3.4\text{V}$ to $3\text{V}$ , $I_{OUT} = 5\text{ mA}$ , $T_R = T_F = 5\ \mu\text{s}$ , DM = 1			4	mV
$\Delta V_{OUT}$	Load Regulation FP Mode	From 0 to 80 mA and from 90% to 10% $I_{OUT}$ , $V_{BAT} = 3.4\text{V}$ , DM = 0			2.9 (4.2 at 5.5V)	mV
$\Delta V_{PEAK}$	Load Regulation Transient FP Mode	From 0 to $I_{OUT(MAX)}$ and from 90% to 10% $I_{OUT(MAX)}$ , $T_R = T_F = 5\ \mu\text{s}$ , $V_{BAT} = 3.4\text{V}$ , DM = 0			23	mV
$\Delta V_{OUT}$	Load Regulation LP Mode	From 0 to 80 mA & from 90% to 10% $I_{OUT(MAX)}$ , $V_{BAT} = 3.4\text{V}$ , DM = 1			5 (7.8 at 5.5V)	mV
PSRR	Ripple Rejection	F = 217 Hz	40	45		dB
$V_N$	Output Noise FP mode	BW: 10 Hz to 100 kHz			80	$\mu\text{V}_{RMS}$
$V_N$	Output Noise LP Mode	BW: 10 Hz to 100 kHz			300	$\mu\text{V}_{RMS}$
$T_R$	Rise Time FP	$I_{OUT} = I_{OUT(MAX)}$	70		130	$\mu\text{s}$
$T_R$	Rise Time LP	$I_{OUT} = I_{OUT(MAX)}$	50		170	$\mu\text{s}$
$I_{SD}$	Shut Down Current				1	$\mu\text{A}$
$I_{SC}$	Short Circuit Current		100		130	mA

**Table 5.** LDO1 External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		1.98	2.2	2.42	$\mu\text{F}$
$C_{ESR}$	Output Capacitor ESR	100 kHz			50	mOhm

## LDO2 Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.

**Table 6.** LDO2 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage	DV = 0	2.65	2.70	2.75	V
$V_{OUT}$	Output Voltage	DV = 1	2.75	2.80	2.85	V
$I_{OUT}$	Output Current			80	130	mA
$I_{QC}$	Quiescent Current			195	236	$\mu\text{A}$
$\Delta V_{OUT}$	Line Regulation	$V_{BAT}: 3\text{V}$ to $3.4\text{V}$ , $I_{OUT} = 130\text{ mA}$		1	2	mV
$\Delta V_{PEAK}$	Line Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.5	2.85	mV
$\Delta V_{OUT}$	Load Regulation	10% - 90% $I_{OUT}$ ; $V_{BAT} = 3\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.0\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.5\text{V}$			1	mV
$\Delta V_{PEAK}$	Load Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.2	2.4	mV
PSRR	Ripple rejection	$F = 217\text{ Hz}$ , $V_{BAT} = 3.6\text{V}$		70	73	dB
$V_N$	Output Noise	BW: 10 Hz to 100 kHz		29	37	$\mu\text{V}_{RMS}$
$T_R$	Rise Time	100% $I_{OUT}$ , 10% - 90% $V_{OUT}$			50	$\mu\text{s}$
$I_{SD}$	Shut Down Current				1	$\mu\text{A}$

**Table 7.** LDO2 External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		1.98	2.2	2.42	$\mu\text{F}$
$C_{ESR}$	Output Capacitor ESR	100 kHz			50	mOhm

## LDO3 Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.

**Table 8.** LDO3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage		2.74	2.8	2.86	V
$I_{OUT}$	Output Current			80	130	mA
$I_{QC}$	Quiescent Current			195	236	$\mu\text{A}$
$\Delta V_{OUT}$	Line Regulation	$V_{BAT}: 3\text{V}$ to $3.4\text{V}$ , $I_{OUT} = 130\text{ mA}$		1	2	mV
$\Delta V_{PEAK}$	Line Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.5	2.85	mV
$\Delta V_{OUT}$	Load Regulation	10% - 90% $I_{OUT}$ ; $V_{BAT} = 3\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.0\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.5\text{V}$			1	mV
$\Delta V_{PEAK}$	Load Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.2	2.4	mV
PSRR	Ripple rejection	$F = 217\text{ Hz}$ , $V_{BAT} = 3.6\text{V}$	70	73		dB
$V_N$	Output Noise	BW: 10 Hz to 100 kHz		29	37	$\mu\text{V}_{RMS}$
$T_R$	Rise Time	100% $I_{OUT}$ , 10% - 90% $V_{OUT}$			50	$\mu\text{s}$
$I_{SD}$	Shut Down Current				1	$\mu\text{A}$

**Table 9.** LDO3 External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		1.98	2.2	2.42	$\mu\text{F}$
$C_{ESR}$	Output Capacitor ESR	100 kHz			50	mOhm



## LDO4 Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.

**Table 10.** LDO4 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage		2.74	2.8	2.86	V
$I_{OUT}$	Output Current			80	130	mA
$I_{QC}$	Quiescent Current			195	236	$\mu\text{A}$
$\Delta V_{OUT}$	Line Regulation	$V_{BAT}: 3\text{V}$ to $3.4\text{V}$ , $I_{OUT} = 130\text{ mA}$		1	2	mV
$\Delta V_{PEAK}$	Line Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.5	2.85	mV
$\Delta V_{OUT}$	Load Regulation	10% - 90% $I_{OUT}$ ; $V_{BAT} = 3\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.0\text{V}$			1	mV
		10% - 90% $I_{OUT}$ ; $V_{BAT} = 5.5\text{V}$			1	mV
$\Delta V_{PEAK}$	Load Regulation Transient	Same as above, $T_R = T_F = 5\ \mu\text{s}$		1.2	2.4	mV
PSRR	Ripple rejection	$F = 217\text{ Hz}$ , $V_{BAT} = 3.6\text{V}$	70	73		dB
$V_N$	Output Noise	BW: 10 Hz to 100 kHz		29	37	$\mu\text{V}_{RMS}$
$T_R$	Rise Time	100% $I_{OUT}$ , 10% - 90% $V_{OUT}$			50	$\mu\text{s}$
$I_{SD}$	Shut Down Current				1	$\mu\text{A}$

**Table 11.** LDO4 External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		1.98	2.2	2.42	$\mu\text{F}$
$C_{ESR}$	Output Capacitor ESR	100 kHz			50	mOhm

## LDO5 Electrical Characteristics

$T_{AMB} = -20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{BAT} = 3\text{V}$  to  $4.2\text{V}$  unless otherwise specified.

**Table 12.** LDO5 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{BAT}$	Operating Supply Voltage		3		5.5	V
$V_{OUT}$	Output Voltage	$I_{OUT} < 10\text{mA}$ , $DV = 0$	1.71	1.8	1.89	V
$V_{OUT}$	Output Voltage	$I_{OUT} < 10\text{ mA}$ , $DV = 1$	2.74	2.8	2.86	V
$I_{SD}$	Shut Down Current			0.1	1	$\mu\text{A}$
$I_{QC}$	Low Power Quiescent Current			8	9.5	$\mu\text{A}$
$I_{OUT}$	Output Current			10		mA
$I_{SC}$	Short Circuit Current				40	mA

**Table 13.** LDO5 External Components

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{OUT}$	Output Capacitor Value		198	220	242	nF
$C_{ESR}$	Output Capacitor ESR	100 kHz			50	mOhm



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