

POWER FACTOR CONTROLLER

■ GENERAL DESCRIPTION

The NJM2375/A are active power factor controllers, which limit the harmonic current resulting from the power supply block of electrical devices.

They include a startup timer, an one quadrant multiplier, a zero current detector to ensure critical condition operation, a transconductance error amplifier, high precision reference, a current sensing comparator, and a totem pole output ideally suited for driving a power MOSFET.

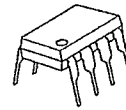
They also contain protection circuits for overvoltage, cycle-by-cycle overcurrent, and maximum peak current.

The startup threshold of NJM2375A is lower than that of NJM2375.

■ FEATURES

- Overvoltage Comparator Eliminates Runaway Output Voltage
- Internal Quick Start
- Internal Startup Timer
- One Quadrant Multiplier
- Zero Current Detector
- High Precision Reference ($\pm 2\%$)
- Totem Pole Output with High State Clamp
- Undervoltage Lockout
(Startup Threshold/NJM2375:13V typ., NJM2375A:10.4V typ.)
- Low Startup and Operating Current
- Bipolar Technology
- Package Outline DIP8, DMP8, SSOP14, SIP8

■ PACKAGE OUTLINE



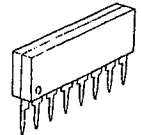
NJM2375D/AD



NJM2375M/AM

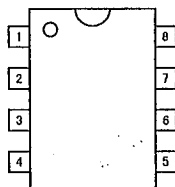


NJM2375V/AV

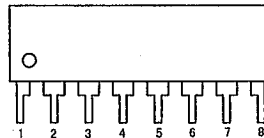


NJM2375L/AL

■ PIN CONFIGURATION



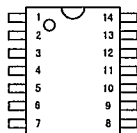
NJM2375D/AD
NJM2375M/AM



NJM2375L/AL

PIN FUNCTION

1. V_{FB}
2. COMP
3. MULT
4. C_{SENCE}
5. D_{ZERO}
6. GND
7. DRIVE
8. V^+



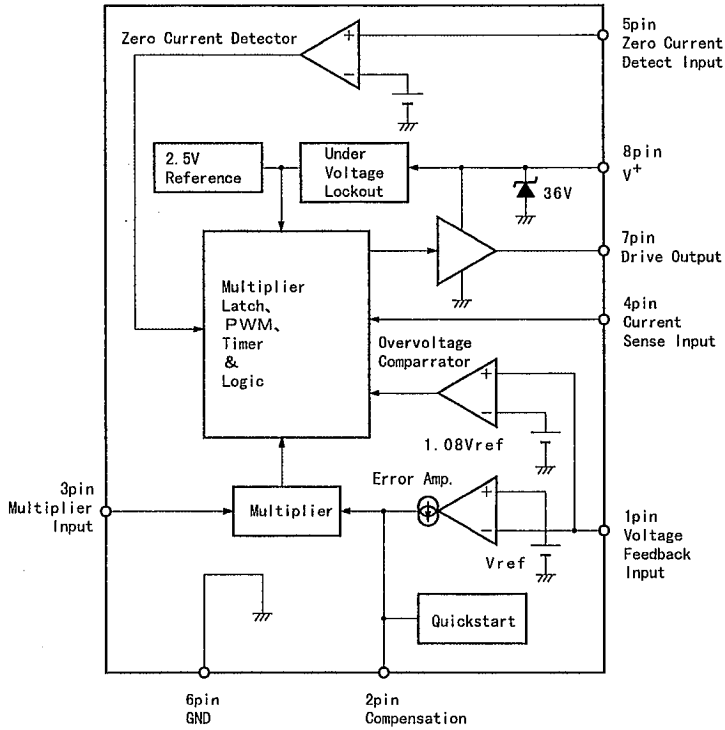
NJM2375V/AV

PIN FUNCTION

- | | |
|----------------|--------------|
| 1. MULT | 8. DRIVE |
| 2. NC | 9. NC |
| 3. C_{SENCE} | 10. V^+ |
| 4. NC | 11. NC |
| 5. D_{ZERO} | 12. V_{FB} |
| 6. NC | 13. NC |
| 7. GND | 14. COMP |

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■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Total Power Supply and Zener Current	$I_{CC} + I_Z$	30	mA
Output Current (Source or Sink)	I_O	500	mA
Current Sense, Multiplier, and Voltage Feedback Inputs	V_{IN}	-1.0~+10	V
Zero Current Detect Input High State Forward Current Low state Forward Current	I_{IN}	50 -10	mA
Power Dissipation	P_D	(DIP8) 500 (DMP8) 300 (SSOP14) 300 (SIP8) 700	mW
Operating Temperature Range	T_{OPR}	-40~+85	°C
Storage Temperature Range	T_{STG}	-50~+150	°C

■ ELECTRICAL CHARACTERISTICS ($V^+=12V^{*1}$, $T_a=25^\circ C$)

● ERROR AMPLIFIER

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Voltage Feedback input Threshold 1	V_{FB1}	$V^+=12V$	2.465	2.500	2.535	V
Voltage Feedback input Threshold 2	V_{FB2}	$V^+=28V$	2.440	2.500	2.540	V
Line Regulation	RegLine	$V^+=12\sim 28V$	—	1.0	10	mV
Input Bias Current	I_{IB}	$V_{FB}=0V$	—	-0.1	-0.5	μA
Transconductance	gm		80	100	130	μmho
Output Current (Source)	I_{OSO}	$V_{FB}=2.3V$	—	10	—	μA
Output Current (Sink)	I_{OSI}	$V_{FB}=2.7V$	—	10	—	μA
Output Voltage Swing 1	$V_{OH(OA)}$	$V_{FB}=2.3V$ (High State)	5.8	6.4	—	V
Output Voltage Swing 2	$V_{OL(OA)}$	$V_{FB}=2.7V$ (Low State)	—	1.7	2.4	V

● OVERVOLTAGE COMPARATOR

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Voltage Feedback Input Threshold	$V_{FB(OV)}$		1.065 $\times V_{FB}$	1.080 $\times V_{FB}$	1.095 $\times V_{FB}$	V

● MULTIPLIER

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Bias Current	I_{IB}	$V_{FB}=0V$ (FB Pin)	—	-0.1	-0.5	μA
Input Threshold	$V_{IH(M)}$	(FB Pin)	1.05 V_{OL} $\times (EA)$	1.20 V_{OL} $\times (EA)$	—	V
Dynamic Input Voltage Range	V_{PIN3}	Multiplier Input Pin	0~2.5	0~3.5	—	V
	V_{PIN2}	Compensation Pin	$V_{IH(M)}$ ~	$V_{IH(M)}$ ~	—	V
Multiplier Gain ^{**2}	K	$V_{mp}=0.5V$, $V_{comp}=V_{IH(M)}+1.0V$	0.43 +1.0V	0.65 +1.5V	0.87	μmho

● ZERO CURRENT DETECTOR

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage	V_{IH}	V^+ Increasing	1.33	1.60	1.87	V
Hysteresis	V_H	V^+ Decreasing	100	200	300	mV
Input Clamp Voltage	V_{IH}	High State ($I_{DET}=+3.0mA$)	5.20	5.80	—	V
	V_{IL}	Low State ($I_{DET}=-3.0mA$)	0.30	0.70	1.00	V

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■ ELECTRICAL CHARACTERISTICS ($V^+=12V^{**1}$, $T_a=25^\circ C$)

● CURRENT SENSING COMPARATOR

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Bias Current	I_{IB}	$I_{source}=0V$	—	-0.15	-1.0	μA
Input Offset Voltage	V_{IO}	$V_{source}=1.10V, V_M=0V$	—	9.0	25.0	mV
Maximum Current Sense Input Threshold ^{**3}	$V_{th(MAX)}$		1.30	1.50	1.80	V
Delay to Output	t_{PHL}		—	200	—	nS

● DRIVE OUTPUT

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OL1}	$I_{sink}=20mA$	—	0.3	0.8	V
Low State	V_{OL2}	$I_{sink}=200mA$	—	2.4	3.3	V
Output Voltage	V_{OH1}	$I_{source}=20mA$	9.8	10.3	—	V
High State	V_{OH2}	$I_{source}=200mA$	7.8	8.4	—	V
Output Voltage	$V_{C(MAX)}$	$I_{source}=20mA$	14	16	18	V
High State		$CL=15pF, V^+=30V$				
Output Voltage	t_r	$CL=1.0nF$	—	100	150	nS
Rise Time						
Output Voltage	t_f	$CL=1.0nF$	—	50	120	nS
Fall Time						
Output Voltage with UVLO Activated	$V_{C(UVLO)}$	$V^+=7V, I_{sink}=1.0mA$	—	0.1	0.5	V

● RESTART TIMER

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Restart Time Delay	t_{DLY}		200	620	—	μS

■ ELECTRICAL CHARACTERISTICS (V⁺=12V^{*1}, T_a=25°C)

● UNDERVOLTAGE LOCKOUT

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
(NJM2375)						
Startup Threshold	V _{th(on)}	V ⁺ Increasing	11.5	13.0	14.5	V
Minimum Operating Voltage After Turn-On Hysteresis	V _{shutdown} V _H	V ⁺ Decreasing	7.0 3.8	8.0 5.0	9.0 6.2	V
(NJM2375A)						
Startup Threshold	V _{th(on)}	V ⁺ Increasing	9.4	10.4	11.4	V
Minimum Operating Voltage After Turn-On Hysteresis	V _{shutdown} V _H	V ⁺ Decreasing	6.8 1.4	7.8 2.6	8.8 3.8	V

● TOTAL DEVICE

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Supply Current						
Startup	I _{cc1}	V ⁺ =7.0V	—	0.25	0.4	mA
Operating	I _{cc2}		—	6.5	12	mA
Dynamic Operating	I _{cc3}	50kHz, CL=1.0nF	—	9.0	20	mA
Power Supply Zener Voltage ^{*4}	V _Z	I _{cc} =25mA	30	36	—	V

● NOTES

※1 : Adjust V⁺ above the startup threshold before setting to 12V.

$$\text{※2 : } K = \frac{V_{th(max)}}{V_M \times (V_{comp} - V_{th(M)})}$$

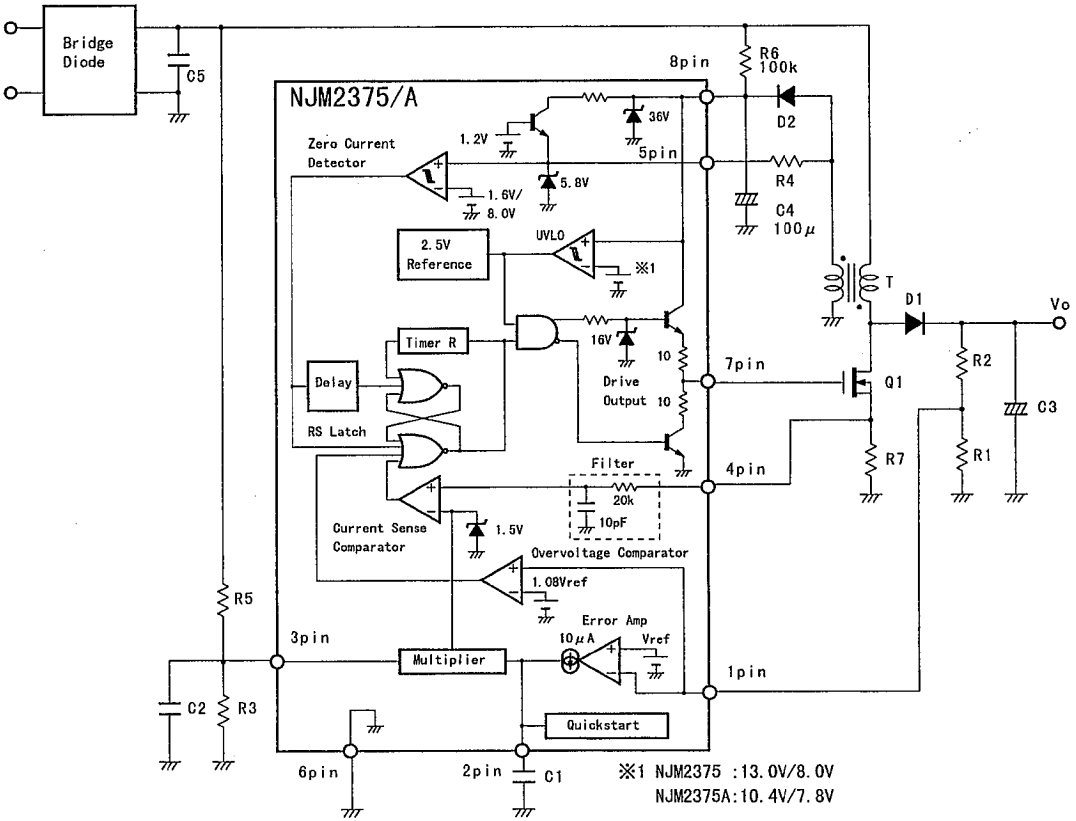
※3 : This parameter is measured with V_{FB}=0V, and V_M=3.0V.

※4 : Do not supply higher voltage above the zener voltage to 8pin, because the internal zener diode protects the IC from surge.

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NJM2375/A

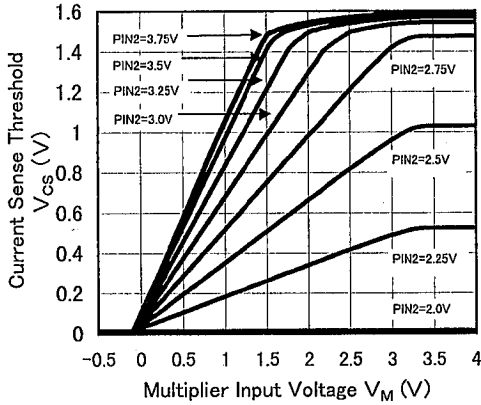
TYPICAL APPLICATIONS



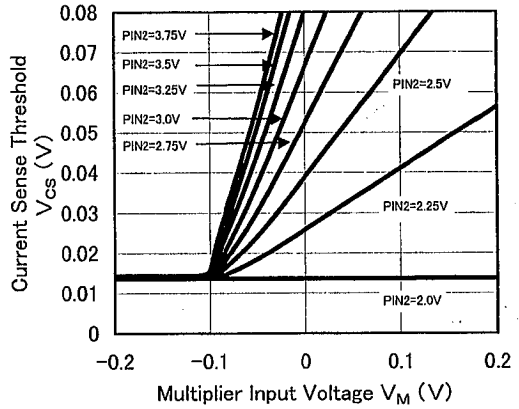
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■ TYPICAL CHARACTERISTICS

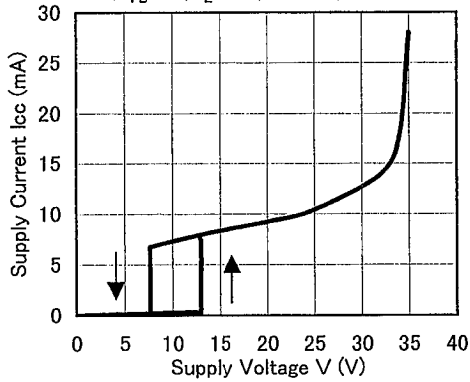
Current Sense Input Threshold vs. Multiplier Input
($V^+=12V, T_a=25^\circ C$)



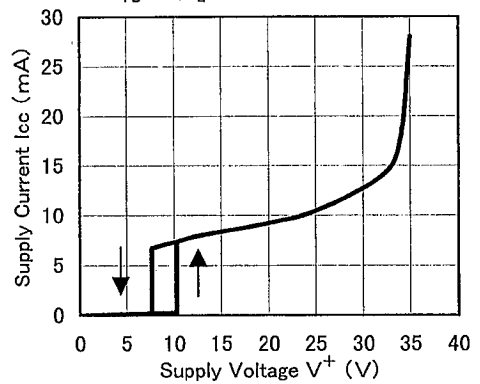
Current Sense Input Threshold vs. Multiplier Input (Expanded View)
($V^+=12V, T_a=25^\circ C$)



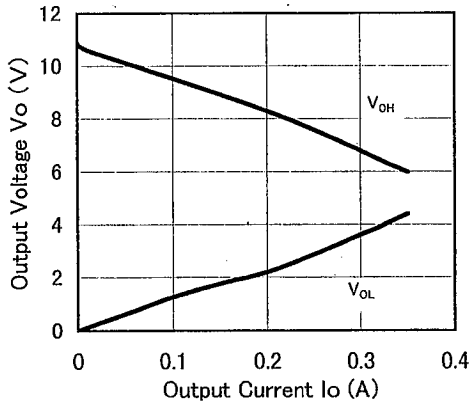
Supply Current vs. Supply Voltage (NJM2375)
($V_{FB}=0V, C_L=1nF, f=50kHz, T_a=25^\circ C$)



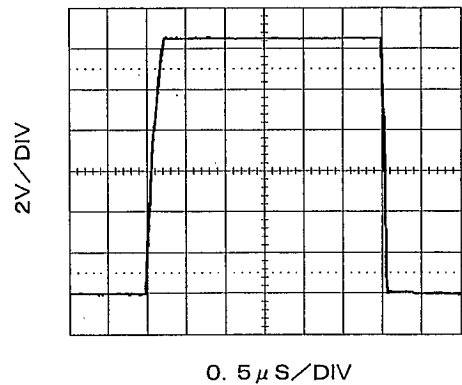
Supply Current vs. Supply Voltage (NJM2375A)
($V_{FB}=0V, C_L=1nF, f=50kHz, T_a=25^\circ C$)



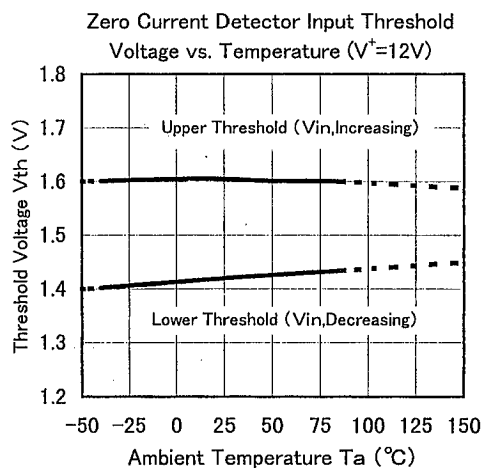
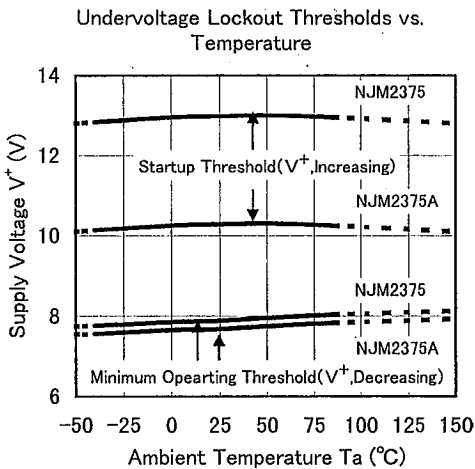
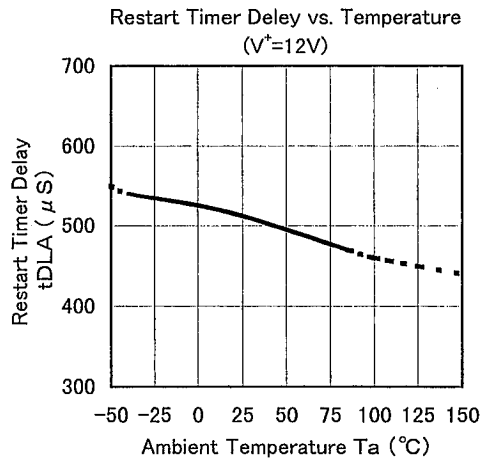
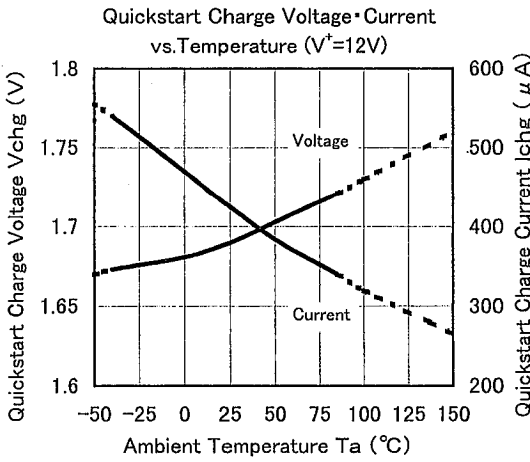
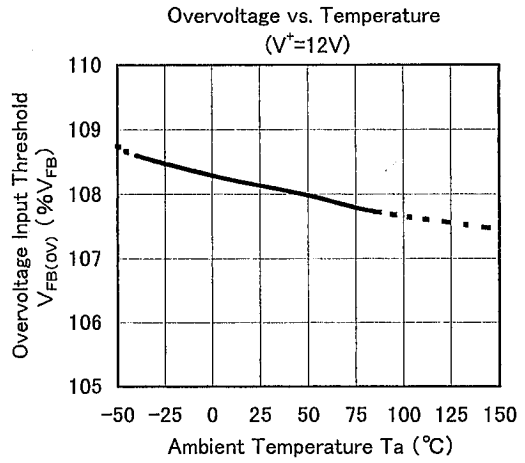
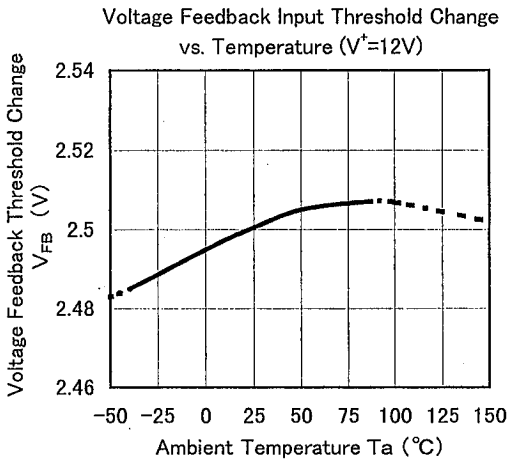
Drive Output Voltage vs. Output Current
($V^+=12V, T_a=25^\circ C$)



Drive Output Waveform
($V^+=12V, C_L=1nF, f=150kHz, T_a=25^\circ C$)



TYPICAL CHARACTERISTICS



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