

## 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.

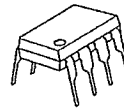
They also contain protection circuits for overvoltage, cycle-by-cycle overcurrent, and maximum peak current.

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



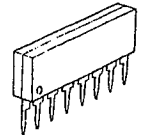
NJM2375D/AD



NJM2375M/AM

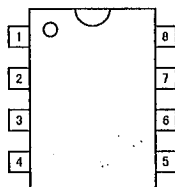


NJM2375V/AV

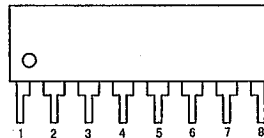


NJM2375L/AL

### ■ PIN CONFIGURATION



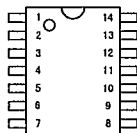
NJM2375D/AD  
NJM2375M/AM



NJM2375L/AL

### PIN FUNCTION

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



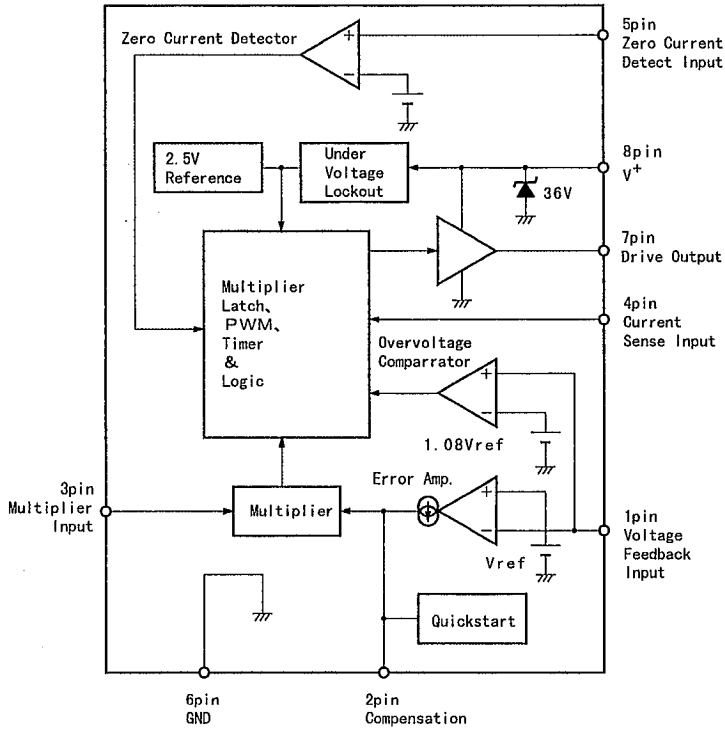
NJM2375V/AV

### 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	$\mu A$
Transconductance	gm		80	100	130	$\mu mho$
Output Current (Source)	$I_{OSO}$	$V_{FB}=2.3V$	—	10	—	$\mu A$
Output Current (Sink)	$I_{OSI}$	$V_{FB}=2.7V$	—	10	—	$\mu A$
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	$\mu A$
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 <sup>**2</sup>	K	$V_{mp}=0.5V$ , $V_{comp}=V_{IH(M)}+1.0V$	+1.0V 0.43	+1.5V 0.65	0.87	$\mu mho$

● 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	$\mu A$
Input Offset Voltage	$V_{IO}$	$V_{source}=1.10V, V_M=0V$	—	9.0	25.0	mV
Maximum Current Sense Input Threshold <sup>**3</sup>	$V_{th(MAX)}$		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	—	$\mu S$

■ ELECTRICAL CHARACTERISTICS (V<sup>+</sup>=12V<sup>\*1</sup>, T<sub>a</sub>=25°C)

● UNDERVOLTAGE LOCKOUT

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

● TOTAL DEVICE

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

● NOTES

※1 : Adjust V<sup>+</sup> above the startup threshold before setting to 12V.

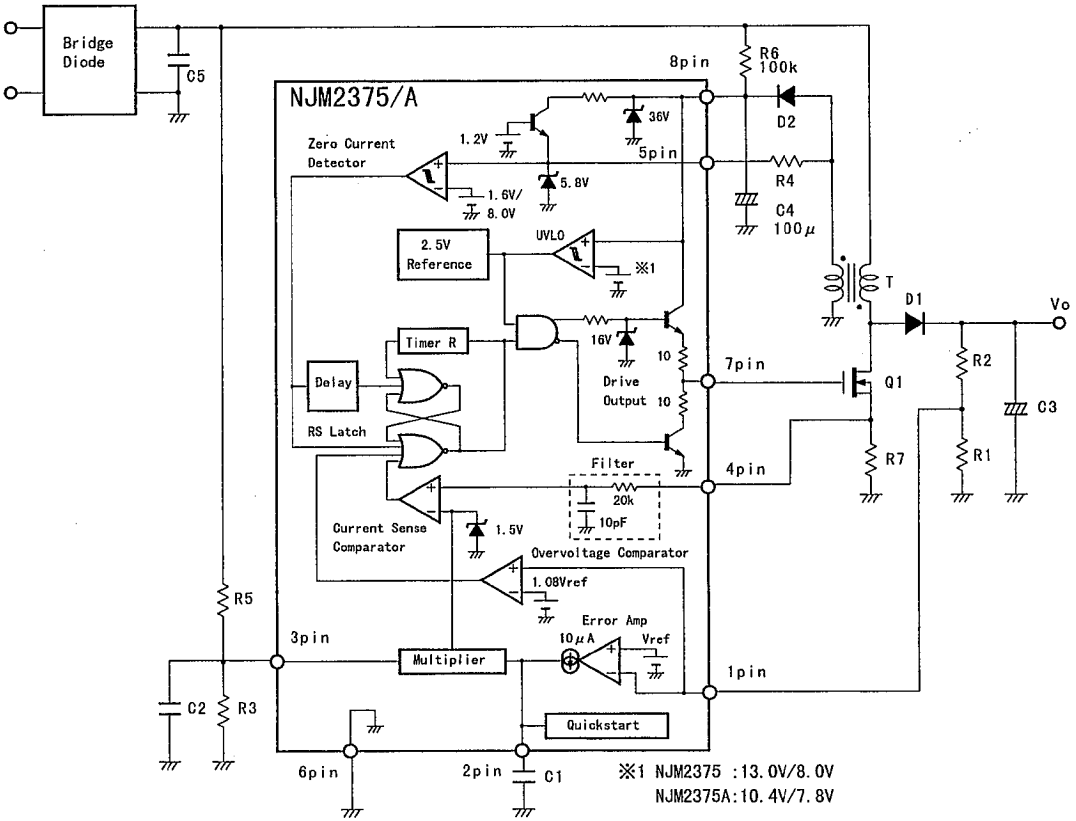
$$\text{※2 : } K = \frac{V_{th(max)}}{V_M \times (V_{comp} - V_{th(M)})}$$

※3 : This parameter is measured with V<sub>FB</sub>=0V, and V<sub>M</sub>=3.0V.

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

# NJM2375/A

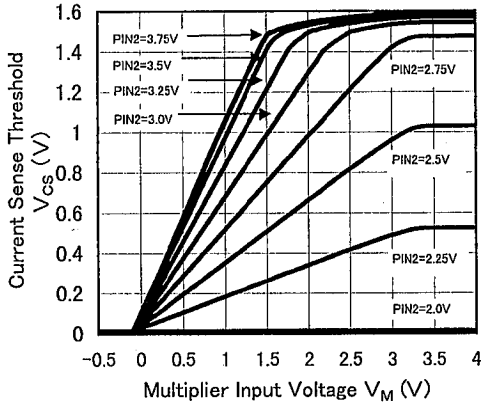
## TYPICAL APPLICATIONS



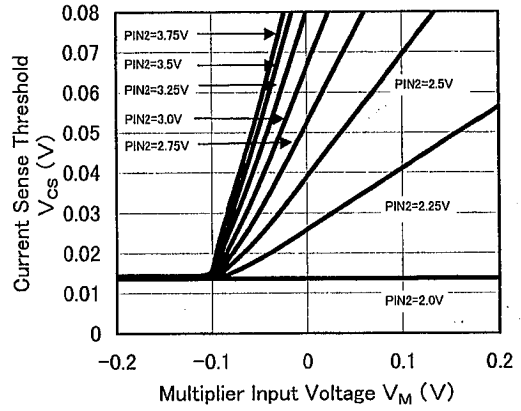
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■ TYPICAL CHARACTERISTICS

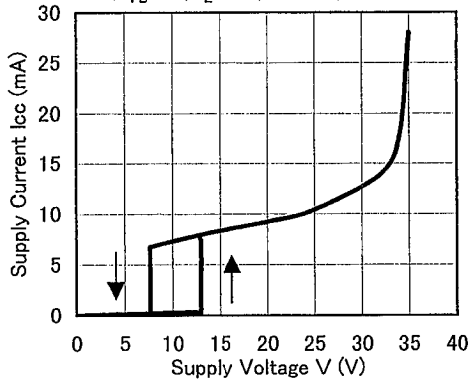
Current Sense Input Threshold vs. Multiplier Input  
( $V^+ = 12V, T_a = 25^\circ C$ )



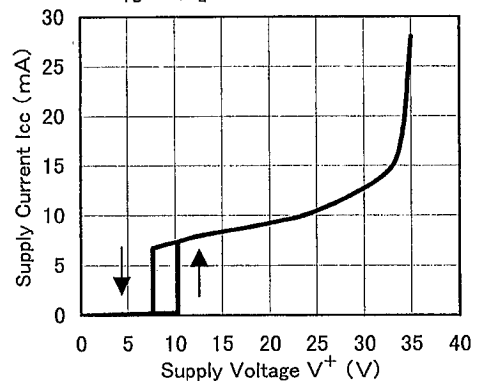
Current Sense Input Threshold vs. Multiplier Input (Expanded View)  
( $V^+ = 12V, T_a = 25^\circ C$ )



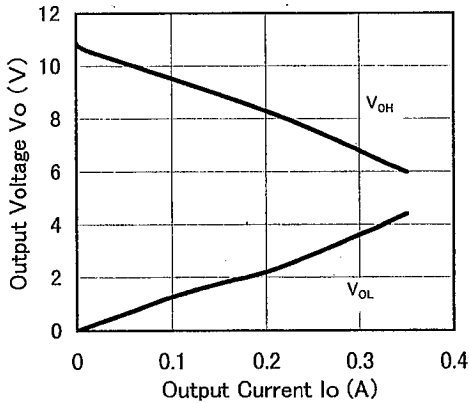
Supply Current vs. Supply Voltage (NJM2375)  
( $V_{FB} = 0V, C_L = 1nF, f = 50kHz, T_a = 25^\circ C$ )



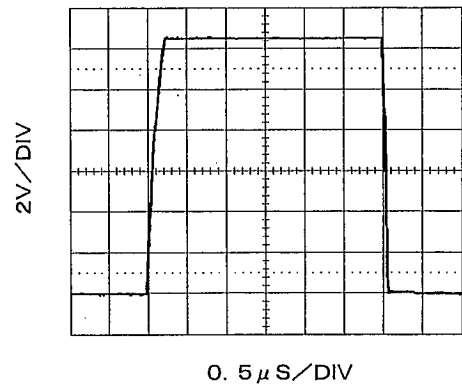
Supply Current vs. Supply Voltage (NJM2375A)  
( $V_{FB} = 0V, C_L = 1nF, f = 50kHz, T_a = 25^\circ C$ )



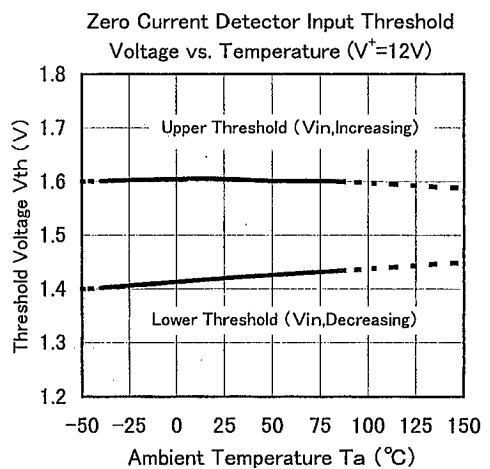
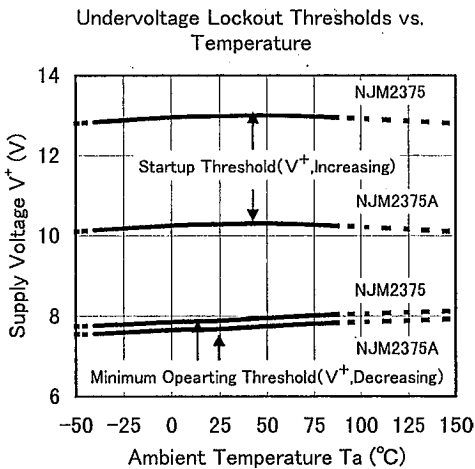
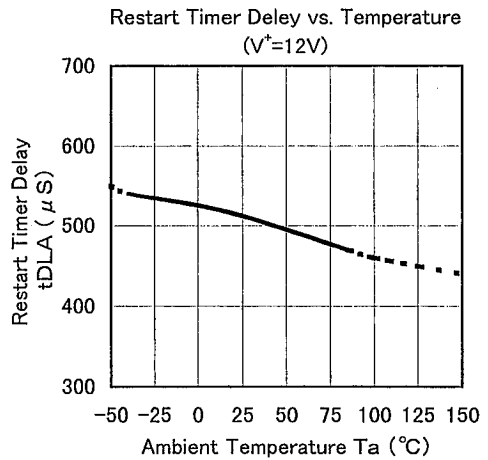
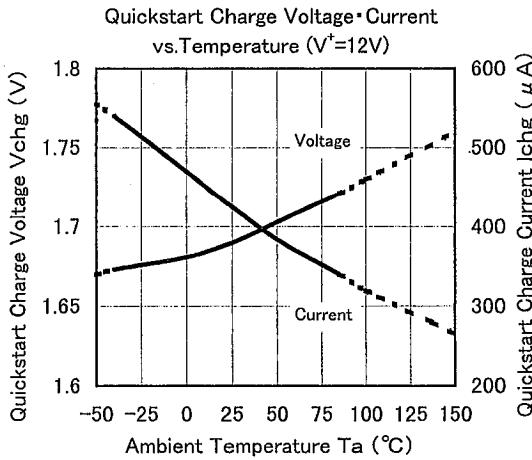
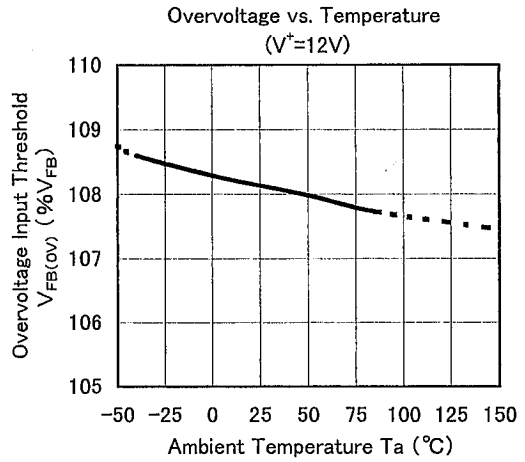
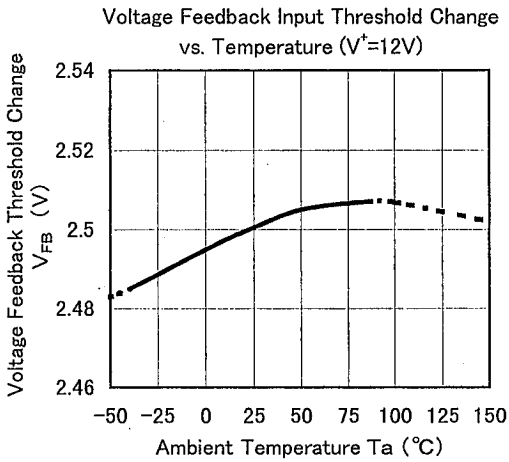
Drive Output Voltage vs. Output Current  
( $V^+ = 12V, T_a = 25^\circ C$ )



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



## TYPICAL CHARACTERISTICS



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## MEMO

[CAUTION]

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