

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.

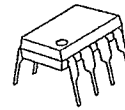
They also contain protection circuits for overvoltage, cycle-by-cycle overcurrent, and maximum peak current.

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



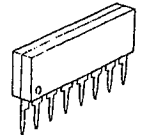
NJM2375D/AD



NJM2375M/AM

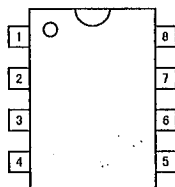
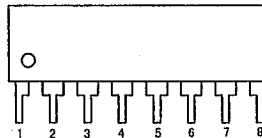


NJM2375V/AV



NJM2375L/AL

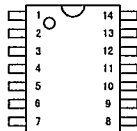
■ PIN CONFIGURATION

NJM2375D/AD
NJM2375M/AM

NJM2375L/AL

PIN FUNCTION

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

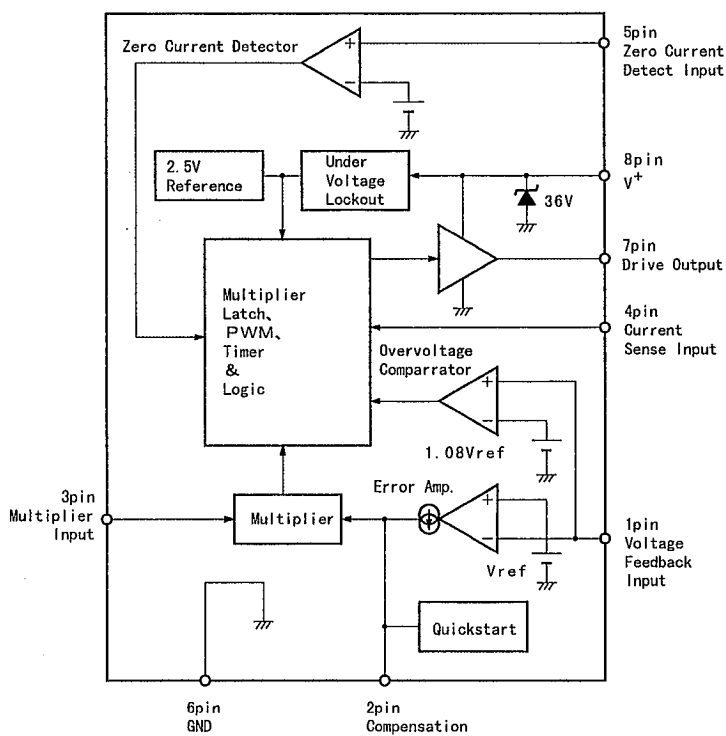


NJM2375V/AV

PIN FUNCTION

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

■ 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	g_m		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	$V_{OH(oss)}$	$V_{FB}=2.3V$ (High State)	5.8	6.4	—	V
Output Voltage Swing 2	$V_{OL(oss)}$	$V_{FB}=2.7V$ (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	$V_{th(M)}$	(FB Pin)	1.05 V_{OL} $\times (EA)$	1.20 V_{OL} $\times (EA)$	—	V
Dynamic Input Voltage Range	V_{PIN3} V_{PIN2}	Multiplier Input Pin Compensation Pin	0~2.5 $V_{th(M)}$ ~ $V_{th(M)}$ +1.0V	0~3.5 $V_{th(M)}$ ~ $V_{th(M)}$ +1.5V	— —	V V
Multiplier Gain $^{※2}$	K	$V_{mp}=0.5V$, $V_{comp}=V_{th(M)}+1.0V$	0.43	0.65	0.87	μmho

● ZERO CURRENT DETECTOR

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage	V_{th}	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}, Ta=25°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 ($V^+=12V^{※1}$, $T_a=25^\circ C$)

● 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	$V_{shut down}$	V^+ Decreasing	7.0	8.0	9.0	V
Hysteresis	V_H		3.8	5.0	6.2	V
(NJM2375A)						
Startup Threshold	$V_{th(on)}$	V^+ Increasing	9.4	10.4	11.4	V
Minimum Operating Voltage After Turn-On	$V_{shut down}$	V^+ Decreasing	6.8	7.8	8.8	V
Hysteresis	V_H		1.4	2.6	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, $C_L=1.0nF$	—	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.

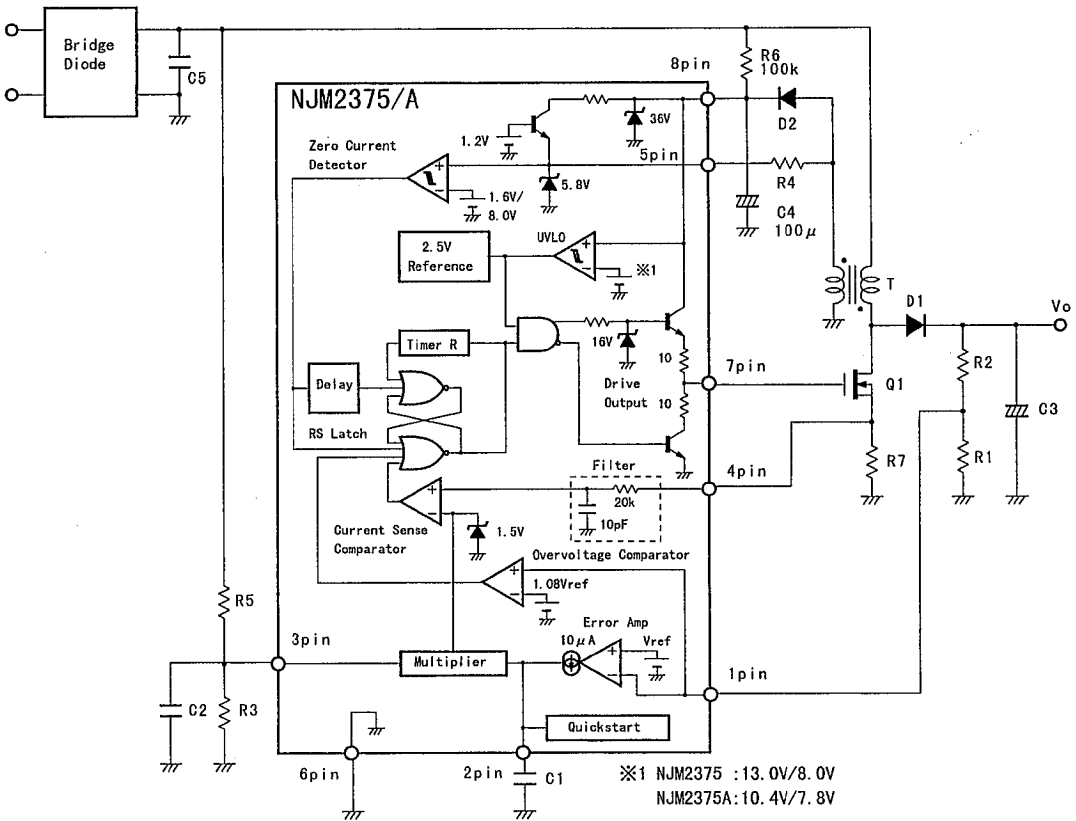
$$※2 : K = \frac{V_{th(max)}}{V_M \times (V_{comp} - V_{th(M)})}$$

※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.

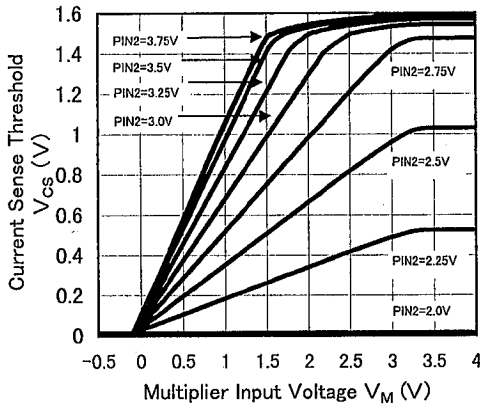
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■ TYPICAL APPLICATIONS

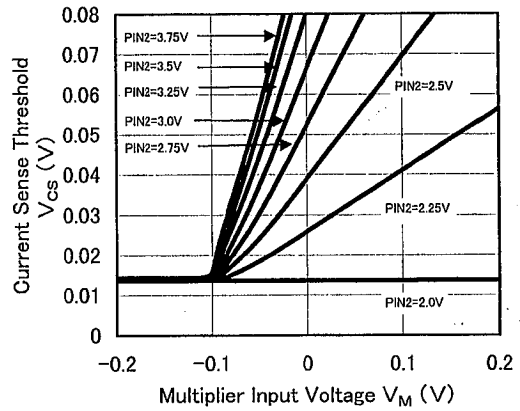


■ TYPICAL CHARACTERISTICS

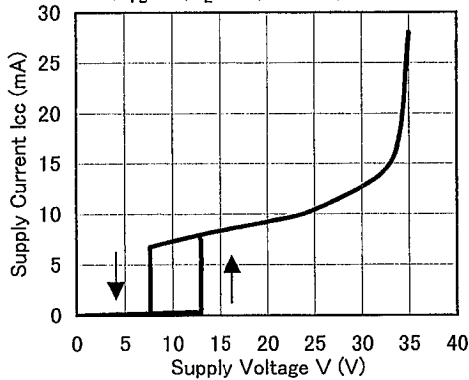
Current Sense Input Threshold
vs. Multiplier Input
($V^+=12V, T_a=25^\circ C$)



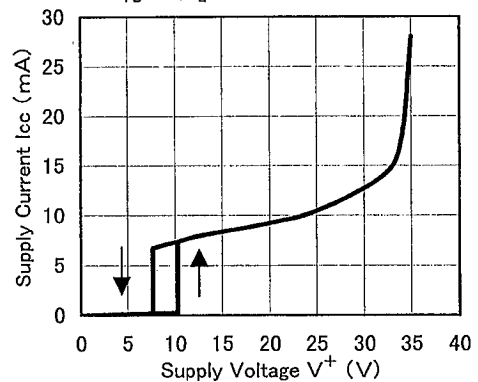
Current Sense Input Threshold
vs. Multiplier Input (Expanded View)
($V^+=12V, T_a=25^\circ C$)



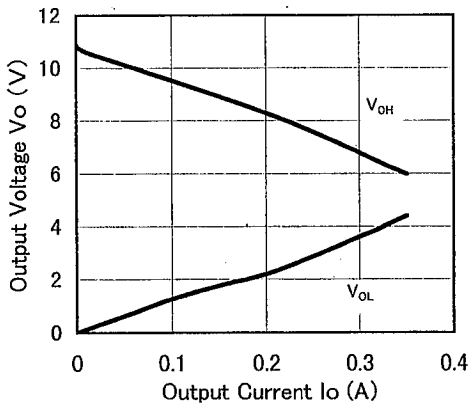
Supply Current vs. Supply Voltage
(NJM2375)
($V_{FB}=0V, C_L=1nF, f=50kHz, T_a=25^\circ C$)



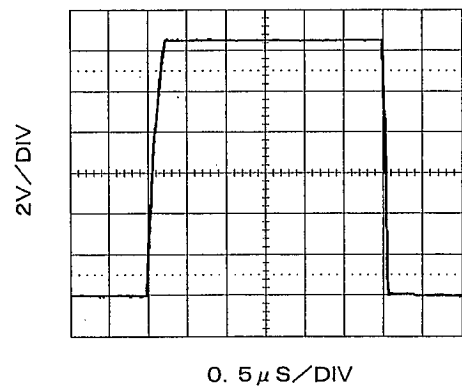
Supply Current vs. Supply Voltage
(NJM2375A)
($V_{FB}=0V, C_L=1nF, f=50kHz, T_a=25^\circ C$)



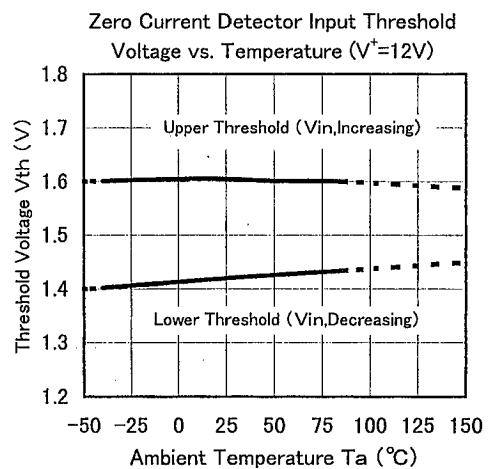
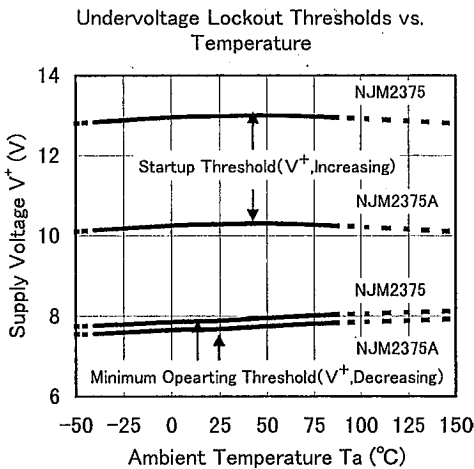
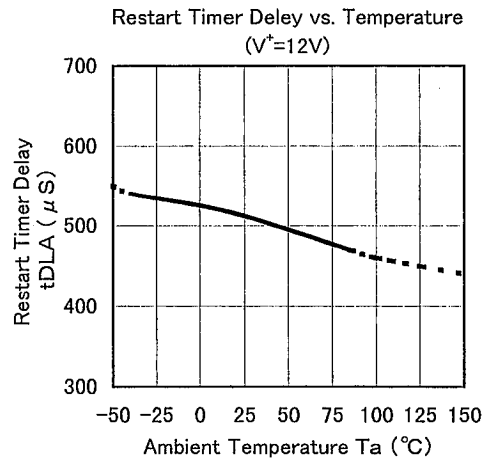
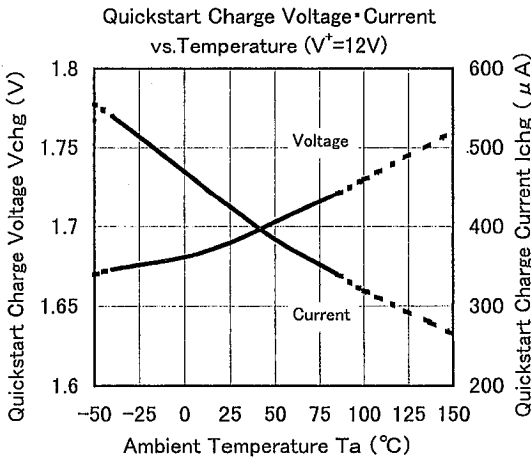
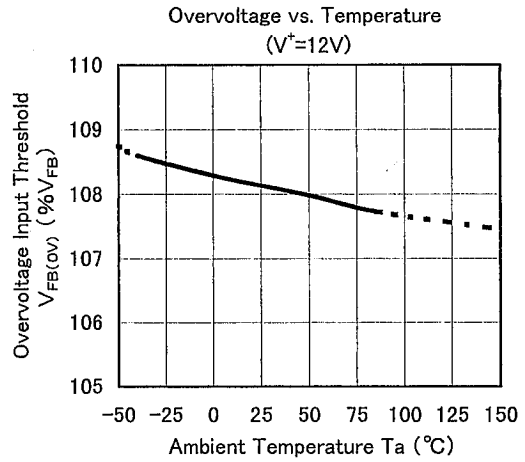
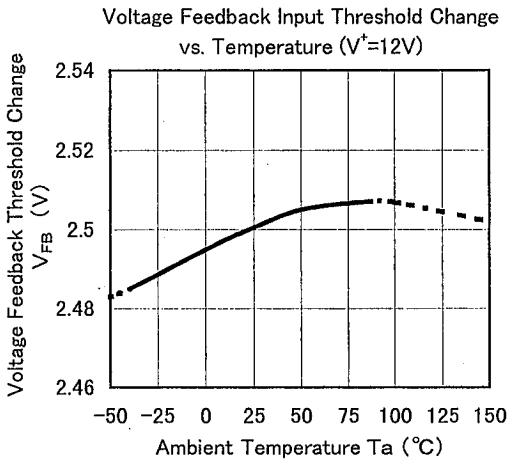
Drive Output Voltage vs. Output Current
($V^+=12V, T_a=25^\circ C$)



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



TYPICAL CHARACTERISTICS



MEMO

[CAUTION]

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