POWER FACTOR CONTROLLER

■ GENERAL DESCRIPTION

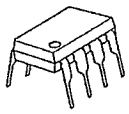
The **NJM2375/A** are active power factor controllers, which limit the harmonic current resulting from the power supply block of electrical devices.

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**.

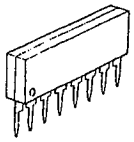
■ PACKAGE OUTLINE



NJM2375D/AD

NJM2375M/AM

NJM2375V/AV

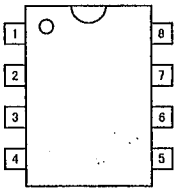


NJM2375L/AL

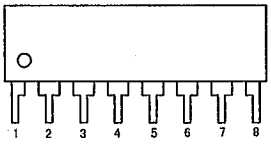
■ FEATURES

- Overvoltage Comparator Eliminates Runaway Output Voltage
- Internal Quick Start
- Internal Startup Timer
- One Quadrant Multiplier
- Zero Current Detector
- High Precision Reference (±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

■ PIN CONFIGURATION



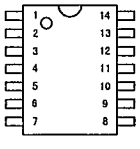
NJM2375D/AD
NJM2375M/AM



NJM2375L/AL

PIN FUNCTION

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

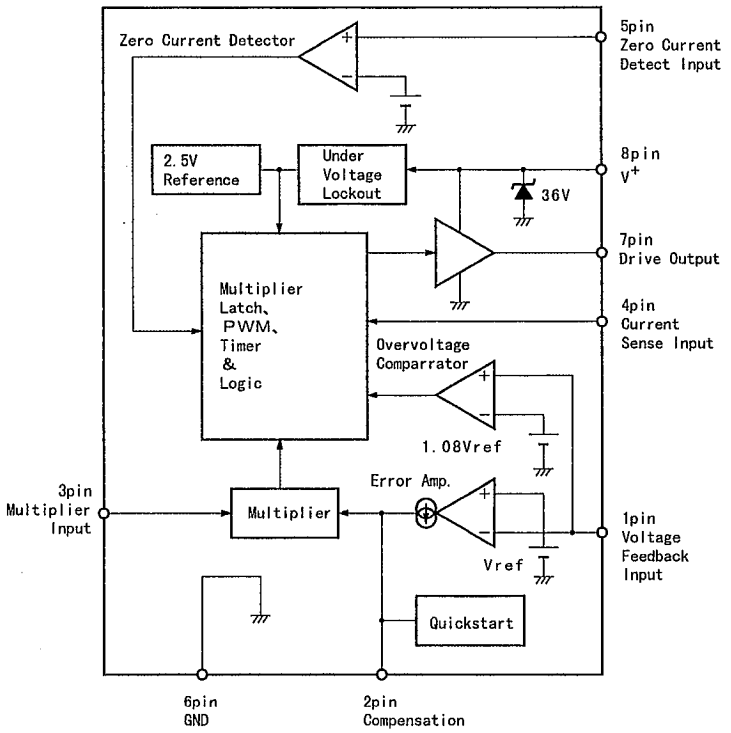


NJM2375V/AV

PIN FUNCTION

1. M_{ULT}	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. C_{OMP}

■ 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, Ta=25°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^+=12～28V	—	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	$V_{OH(EA)}$	V_{FB}=2.3V (High State)	5.8	6.4	—	V
Output Voltage Swing 2	$V_{OL(EA)}$	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 × V_{FB}	1.080 × V_{FB}	1.095 × 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)	1.05V_{OL} × (EA)	1.20V_{OL} × (EA)	—	V
Dynamic Input Voltage Range	V_{PIN3}	Multiplier Input Pin	0～2.5	0～3.5	—	V
	V_{PIN2}	Compensation Pin	$V_{th(M)}$ ～ $V_{th(M)}$ +1.0V	$V_{th(M)}$ ～ $V_{th(M)}$ +1.5V	—	V
Multiplier Gain※2	K	Vmp=0.5V, Vcomp=$V_{th(M)}$ +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
Hysteressis	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_{sence}=0V	—	-0.15	-1.0	μA
Input Offset Voltage	V_{IO}	V_{compo}=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	tPHL		—	200	—	nS

●DRIVE OUTPUT

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage Low State	V_{OL1}	I_{sink}=20mA	—	0.3	0.8	V
	V_{OL2}	I_{sink}=200mA	—	2.4	3.3	V
Output Voltage High State	V_{OH1}	I_{source}=20mA	9.8	10.3	—	V
	V_{OH2}	I_{source}=200mA	7.8	8.4	—	V
Output Voltage High State	$V_{C(MAX)}$	I_{source}=20mA CL=15pF, V^+=30V	14	16	18	V
Output Voltage Rise Time	tr	CL=1.0nF	—	100	150	nS
Output Voltage Fall Time	tf	CL=1.0nF	—	50	120	nS
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	tDLY		200	620	—	μS

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■ ELECTRICAL CHARACTERISTICS (V^+=12V※1, Ta=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	$V_{shutdown}$	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	$V_{shutdown}$	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, 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.

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

※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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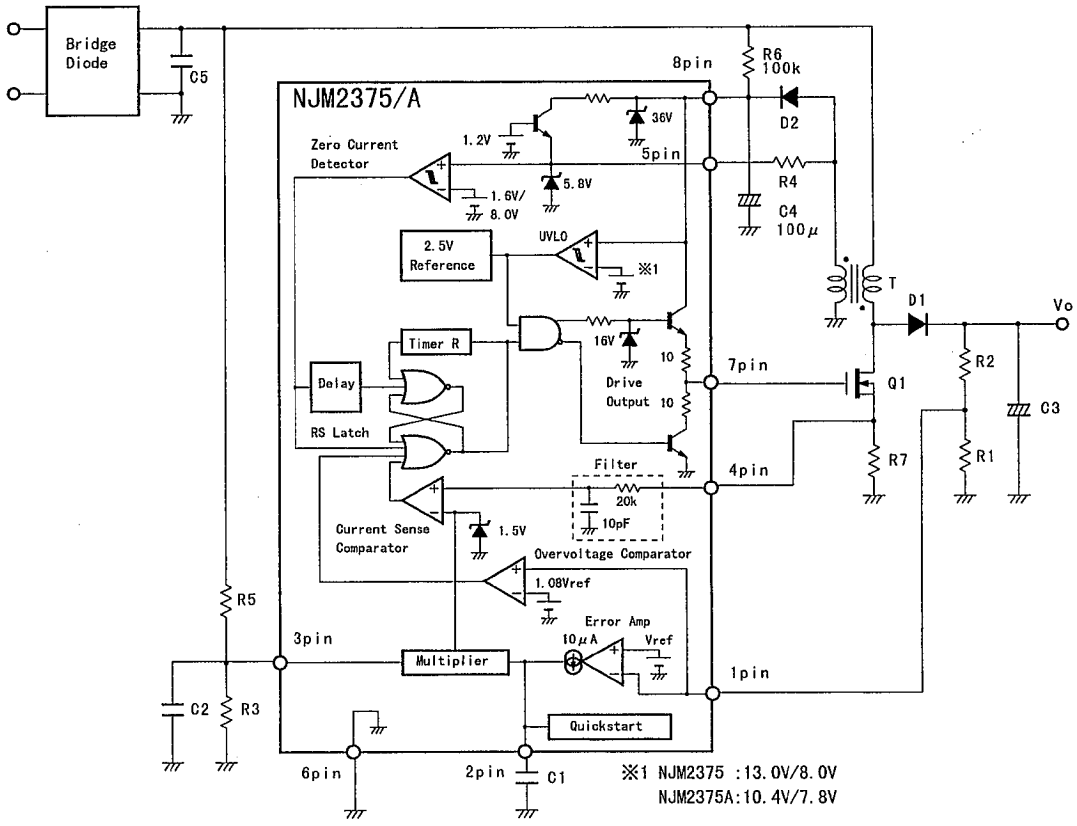
■ TYPICAL APPLICATIONS



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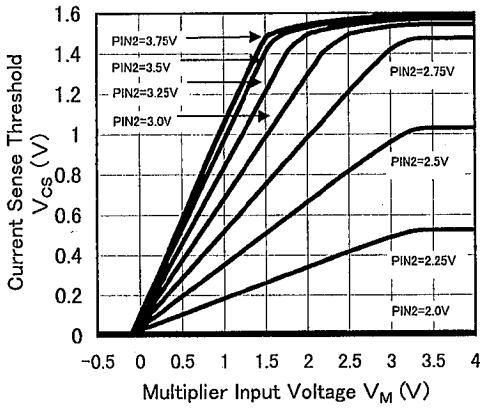
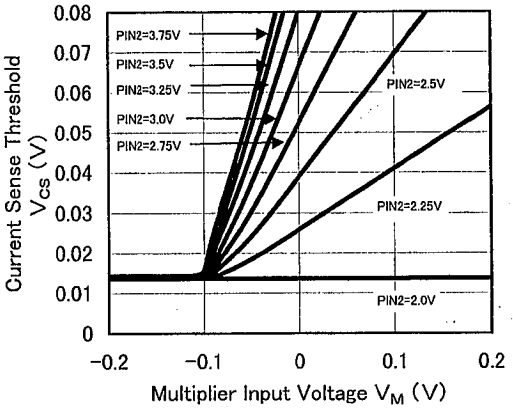
■ TYPICAL CHARACTERISTICS

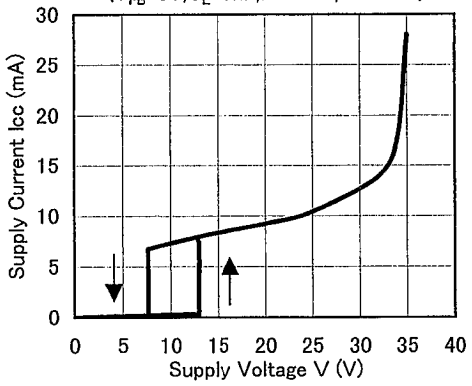
Current Sense Input Threshold vs. Multiplier Input (V^+=12V,Ta=25°C)



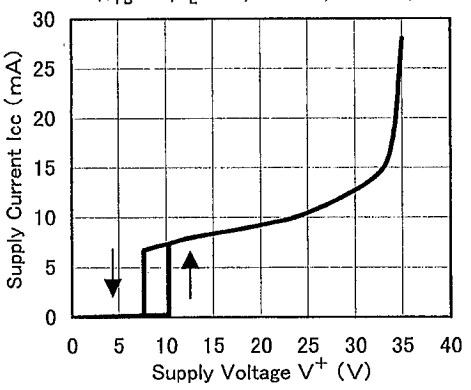
Current Sense Input Threshold vs. Multiplier Input (Expanded View) (V^+=12V,Ta=25°C)



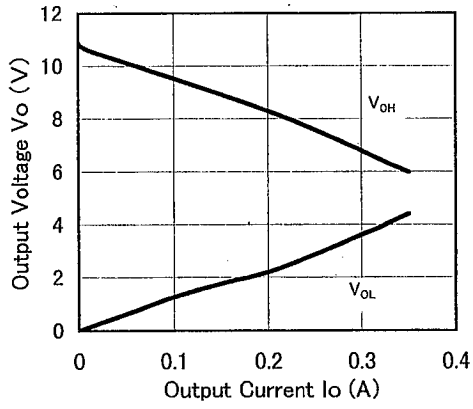
Supply Current vs. Supply Voltage (NJM2375) (V_{FB}=0V,C_L=1nF,f=50kHz,Ta=25°C)



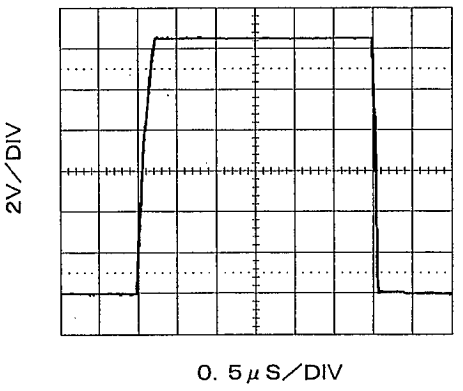
Supply Current vs. Supply Voltage (NJM2375A) (V_{FB}=0V,C_L=1nF,f=50kHz,Ta=25°C)



Drive Output Voltage vs. Output Current (V^+=12V,Ta=25°C)

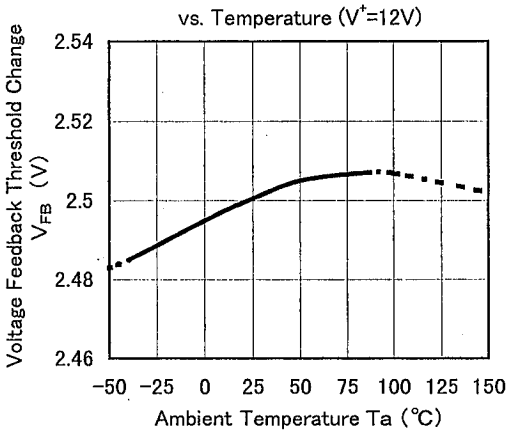


Drive Output Waveform (V^+=12V,C_L=1nF,f=150kHz,Ta=25°C)

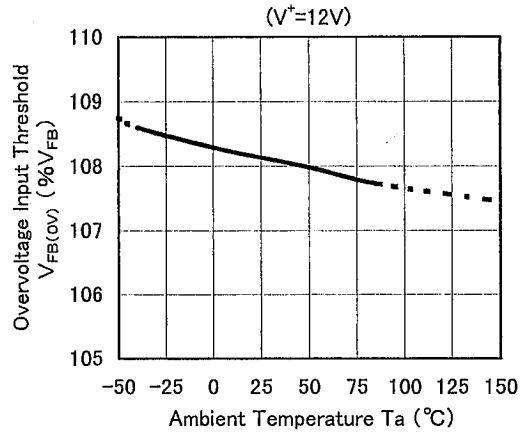


■ TYPICAL CHARACTERISTICS

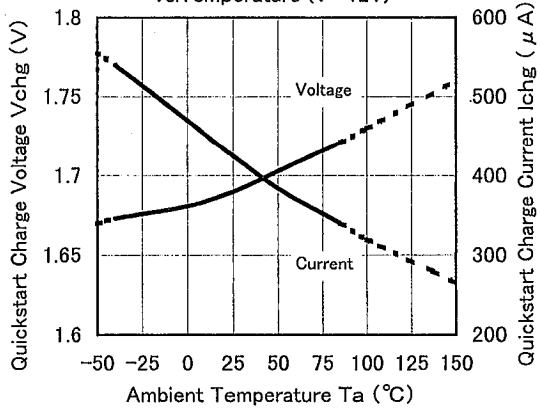
Voltage Feedback Input Threshold Change vs. Temperature (V^+=12V)



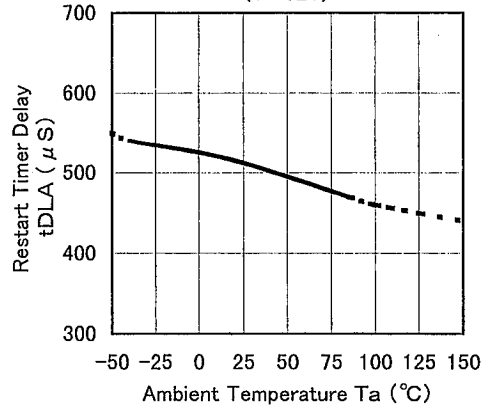
Overvoltage vs. Temperature (V^+=12V)



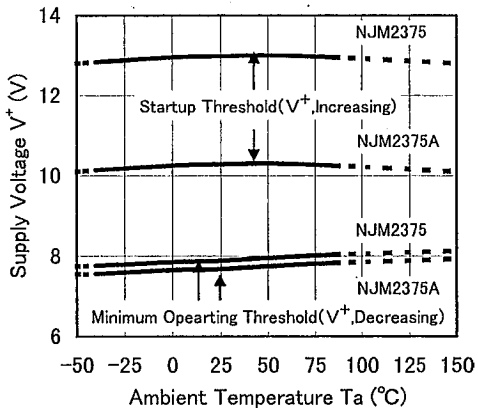
Quickstart Charge Voltage・Current vs.Temperature (V^+=12V)



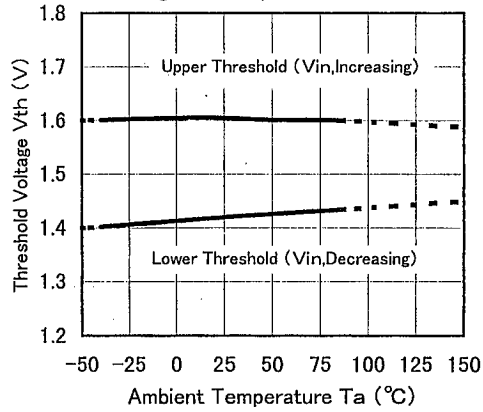
Restart Timer Deley vs. Temperature (V^+=12V)



Undervoltage Lockout Thresholds vs. Temperature



Zero Current Detector Input Threshold Voltage vs. Temperature (V^+=12V)



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MEMO