

## POWER FACTOR CONTROLLER

### ■ GENERAL DESCRIPTION

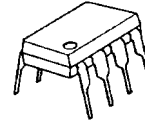
The **NJM2375/A** are active power factor controllers, which limit the harmonic current resulting from the power supply block of electrical devices.

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



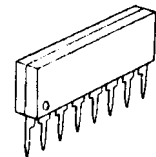
**NJM2375D/AD**



**NJM2375M/AM**



**NJM2375V/AV**

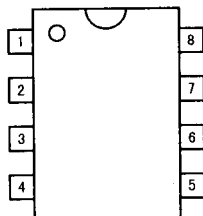


**NJM2375L/AL**

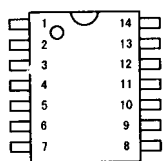
### ■ FEATURES

- Overvoltage Comparator Eliminates Runaway Output Voltage
- Internal Quick Start
- Internal Startup Timer
- One Quadrant Multiplier
- Zero Current Detector
- High Precision Reference ( $\pm 2\%$ )
- 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

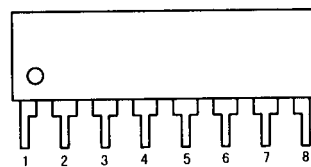
### ■ PIN CONFIGURATION



**NJM2375D/AD**  
**NJM2375M/AM**



**NJM2375V/AV**



**NJM2375L/AL**

#### PIN FUNCTION

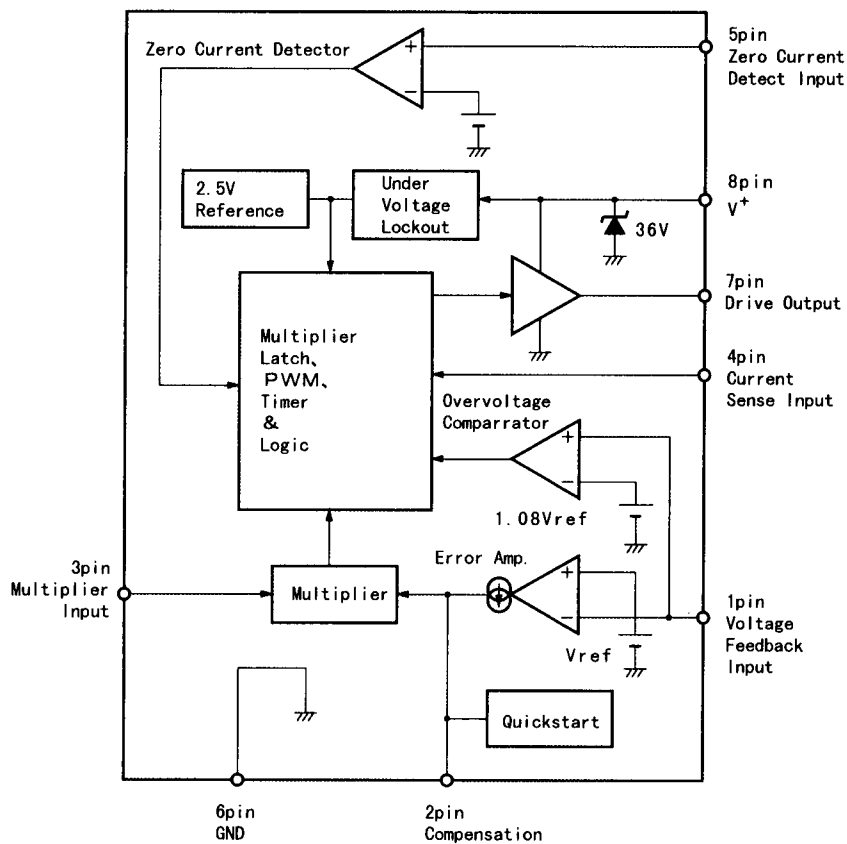
- |                       |                      |
|-----------------------|----------------------|
| 1. M <sub>ULT</sub>   | 8. DRIVE             |
| 2. NC                 | 9. NC                |
| 3. C <sub>SENSE</sub> | 10. V <sup>+</sup>   |
| 4. NC                 | 11. NC               |
| 5. D <sub>ZERO</sub>  | 12. V <sub>FB</sub>  |
| 6. NC                 | 13. NC               |
| 7. GND                | 14. C <sub>OMP</sub> |

#### PIN FUNCTION

1. V<sub>FB</sub>
2. C<sub>OMP</sub>
3. M<sub>ULT</sub>
4. C<sub>SENSE</sub>
5. D<sub>ZERO</sub>
6. GND
7. DRIVE
8. V<sup>+</sup>

# NJM2375/A

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub>=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Total Power Supply and Zener Current	I <sub>CC+Iz</sub>	30	mA
Output Current (Source or Sink)	I <sub>O</sub>	500	mA
Current Sense, Multiplier, and Voltage Feedback Inputs	V <sub>IN</sub>	-1.0 to +10	V
Zero Current Detect Input			
High State Forward Current	I <sub>IN</sub>	50	mA
Low state Forward Current		-10	
Power Dissipation	P <sub>D</sub>	(DIP8) 500 (DMP8) 300 (SSOP14) 300 (SIP8) 700	mW
Operating Temperature Range	T <sub>OPR</sub>	-40 to +85	°C
Storage Temperature Range	T <sub>STG</sub>	-50 to +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	$V^+=12$ to $28V$	-	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	$V_{OH(ea)}$	$V_{FB}=2.3V$ (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 $\times V_{FB}$	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	$V_{th(M)}$	(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 to 2.5	0 to 3.5	-	V
	$V_{PIN2}$	Compensation Pin	$V_{th(M)}$ to $V_{th(M)}$ +1.0V	$V_{th(M)}$ to $V_{th(M)}$ +1.5V	-	V
Multiplier Gain <sup>*2</sup>	K	$V_{mp}=0.5V$ , $V_{comp}=V_{th(M)}+1.0V$	0.43	0.65	0.87	$\mu mho$

### ● 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

# NJM2375/A

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

### ● CURRENT SENSING COMPARATOR

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Bias Current	$I_{IB}$	$I_{sense}=0V$	-	-0.15	-1.0	$\mu A$
Input Offset Voltage	$V_{IO}$	$V_{compe}=1.10V$ , $V_M=0V$	-	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	-	$\mu S$

■ 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	$V_{shutdown}$	$V^+$ Decreasing	7.0	8.0	9.0	V
Voltage After Turn-On 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	$V_{shutdown}$	$V^+$ Decreasing	6.8	7.8	8.8	V
Voltage After Turn-On 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 <sup>*4</sup>	$V_Z$	$I_{CC}=25mA$	30	36	-	V

● NOTES

\*1 : Adjust  $V^+$  above the startup threshold before setting to 12V.

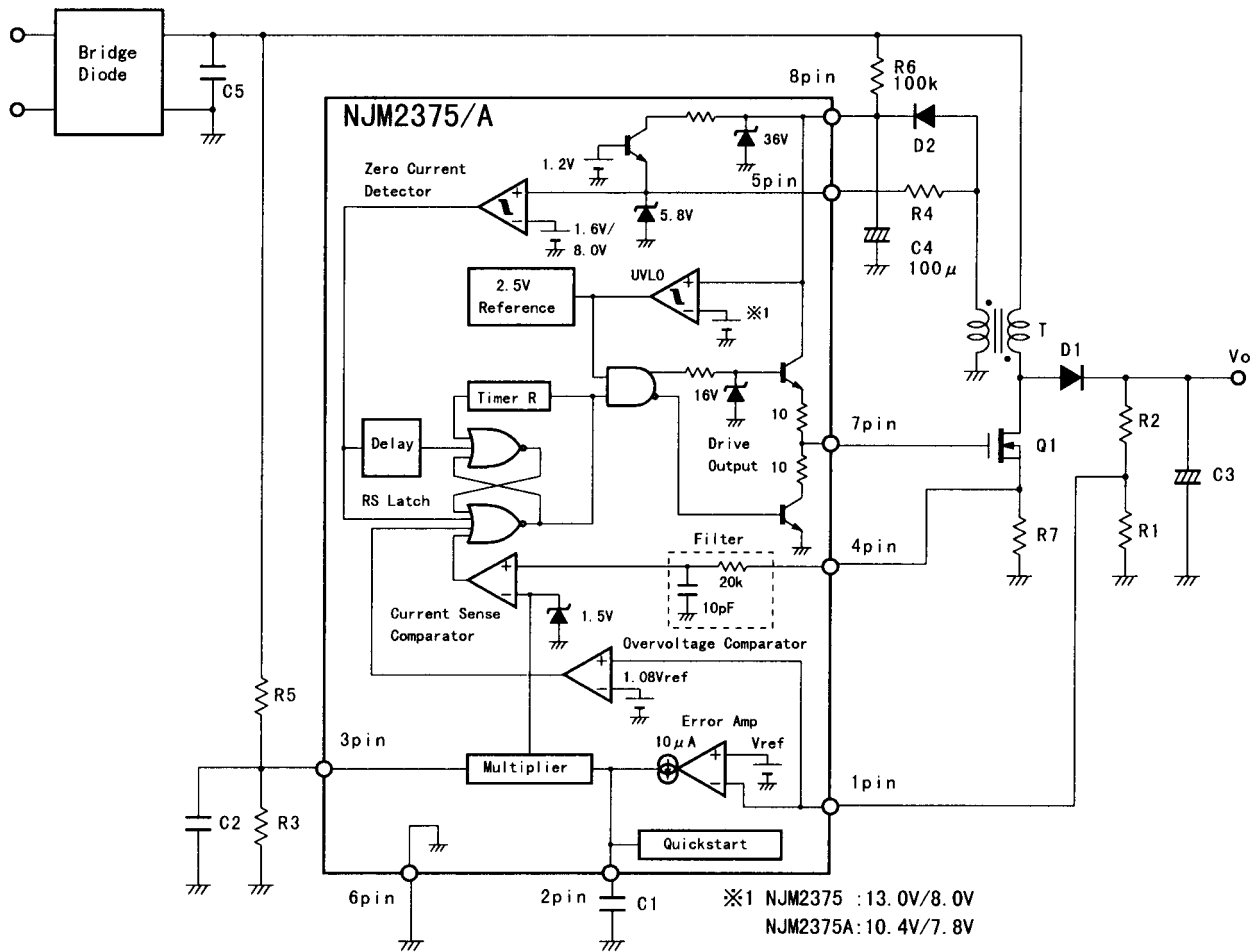
$$*2 : K = \frac{V_{th(max)}}{V_M \times (V_{comp} - V_{th(M)})}$$

\*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.

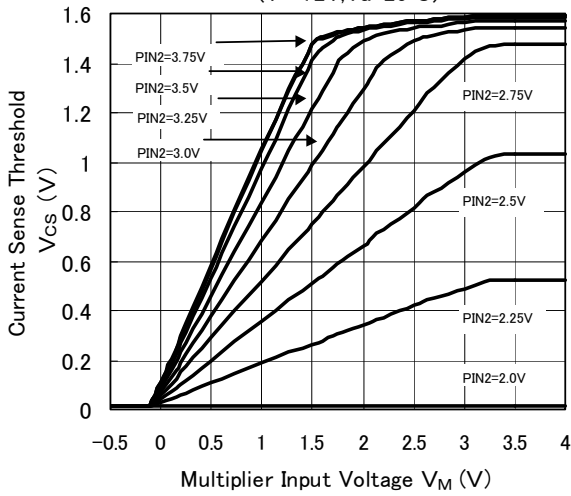
# NJM2375/A

## ■ TYPICAL APPLICATIONS

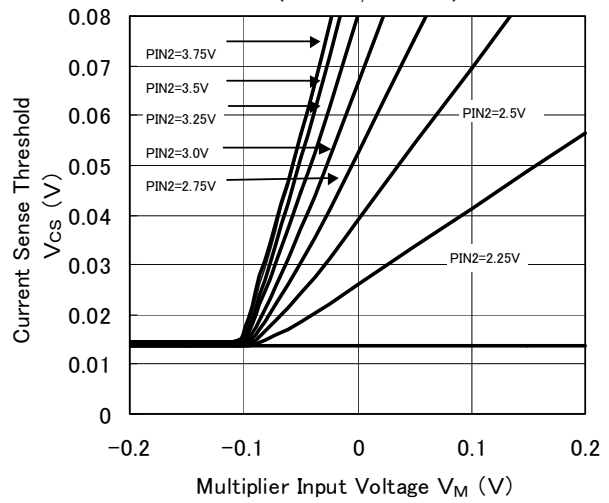


## ■ TYPICAL CHARACTERISTICS

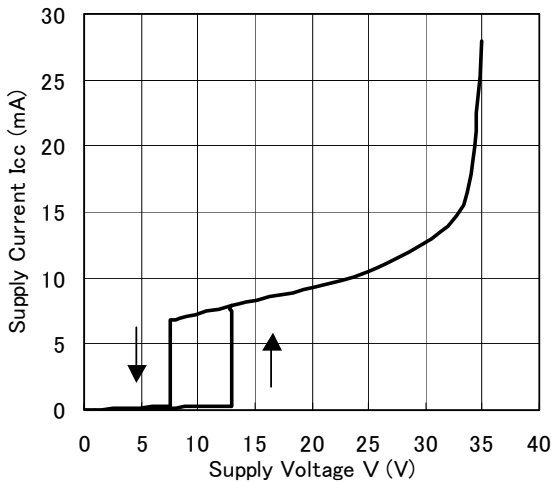
**Current Sense Input Threshold vs. Multiplier Input**  
( $V^+ = 12V, T_a = 25^\circ C$ )



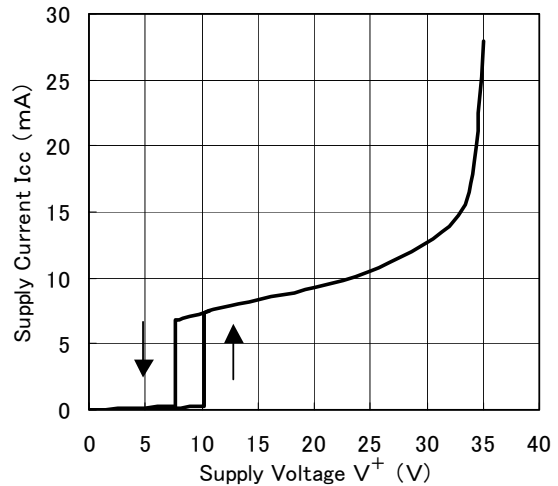
**Current Sense Input Threshold vs. Multiplier Input (Expanded View)**  
( $V^+ = 12V, T_a = 25^\circ C$ )



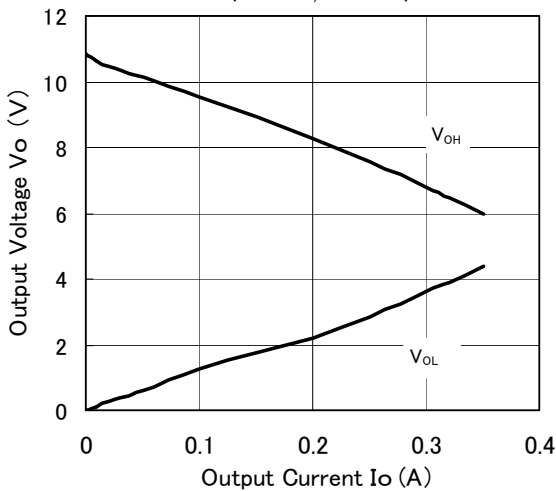
**Supply Current vs. Supply Voltage (NJM2375)**  
( $V_{FB} = 0V, C_L = 1nF, f = 50kHz, T_a = 25^\circ C$ )



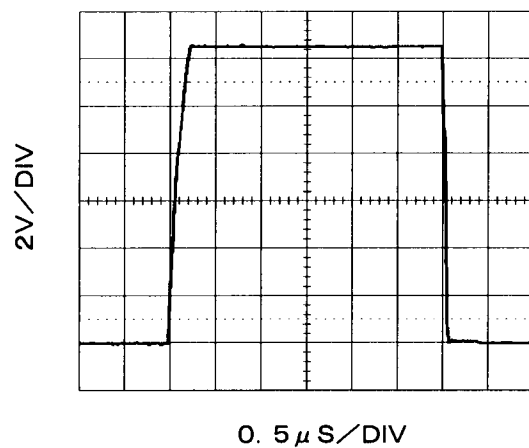
**Supply Current vs. Supply Voltage (NJM2375A)**  
( $V_{FB} = 0V, C_L = 1nF, f = 50kHz, T_a = 25^\circ C$ )



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

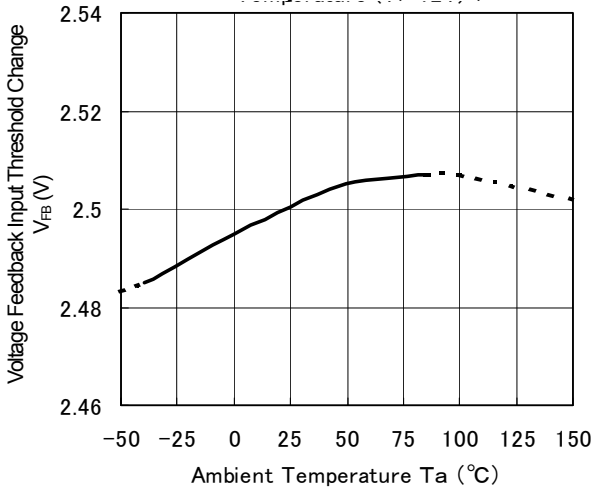


**Drive Output Waveform**  
( $V^+ = 12V, C_L = 1nF, f = 150kHz, T_a = 25^\circ C$ )

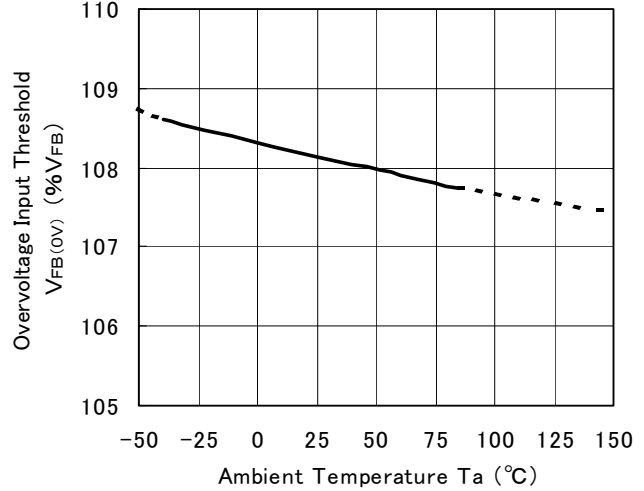


## ■ TYPICAL CHARACTERISTICS

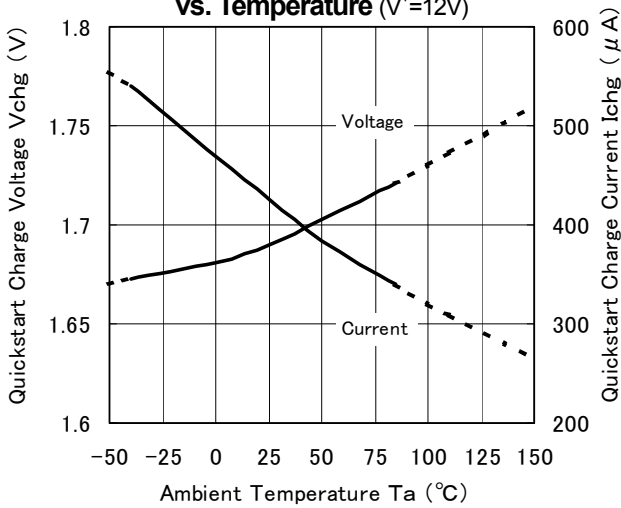
**Voltage Feedback Input Threshold Change vs. Temperature ( $V^+=12V$ )**



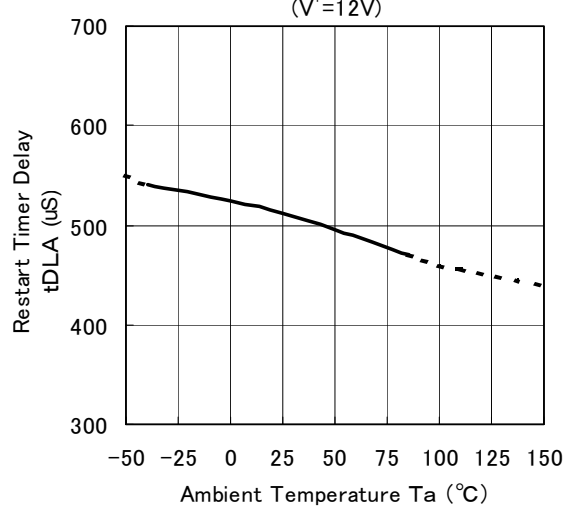
**Overvoltage vs. Temperature ( $V^+=12V$ )**



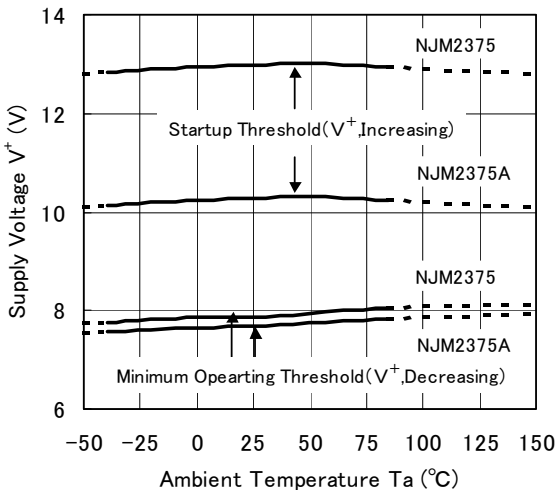
**Quickstart Charge Voltage - Current vs. Temperature ( $V^+=12V$ )**



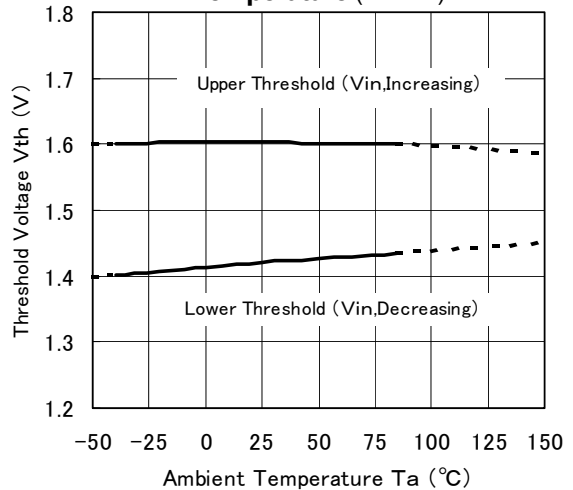
**Restart Timer Delay vs. Temperature ( $V^+=12V$ )**



**Undervoltage Lockout Thresholds vs. Temperature**



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





**[CAUTION]**

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