

# CAT705, CAT706, CAT813

## μP Supervisory Circuits

### Description

The CAT705, CAT706, and CAT813 provide reset and monitoring functions for the electronic systems. Each device monitors the system voltage and maintains a reset output until that voltage reaches the device's specified trip value and then maintains the reset output active condition until the device's internal timer allows the system power supply to stabilize.

The devices have a watchdog input which can be used to monitor a system signal and causes  $\overline{WDO}$  to go low if the signal fails to change state prior to a timeout condition.

The supervisory circuits provide a  $\overline{MR}$  input which initiates a reset if pulled low. The CAT705 and CAT706 provide an active low  $\overline{RESET}$  output. The CAT813 provides an active high RESET output.

There is a secondary supply monitor (PFI) included for power-fail warning.

### Features

- Reset Guaranteed Valid for 1.0 V  $V_{CC}$
- 6  $\mu$ A Supply Current
- 200 ms Reset Pulse Width
- Watchdog Timer Function 1.6 s Timeout
- Accurate Brownout Detection Reset in 3.0, 3.6, and 5.0 Volt Systems
- Secondary Low Supply Monitoring on PFI Input
- Pin and Function Compatible with the MAX705/MAX706/MAX813L Products
- Operating Range from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- SOIC 8-lead and MSOP 8-lead Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Microprocessor and Microcontroller Based Systems
- Instrument and Control Systems
- Portable Equipment



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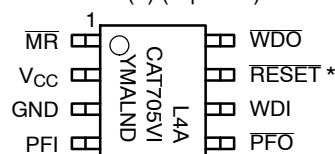
**SOIC-8  
V SUFFIX  
CASE 751BD**



**MSOP-8  
Z SUFFIX  
CASE 846AD**

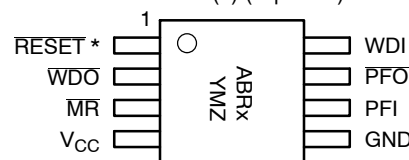
### PIN CONFIGURATIONS AND MARKING DIAGRAMS

SOIC-8 (V) (Top View)



L = Assembly Location Code  
4 = Lead Finish NiPdAu  
A = Product Revision: Fixed as "A"  
CATxxxV = Specific Device Code  
(CAT705V = CAT705 SOIC)  
(CAT706V = CAT706 SOIC)  
(CAT813V = CAT813 SOIC)  
I = Temperature Range (I = Industrial)  
Y = Production Year (Last Digit)  
M = Production Month (1-9, O, N, D)  
ALND = Last Four Assembly Lot Number Digits

MSOP-8 (Z) (Top View)



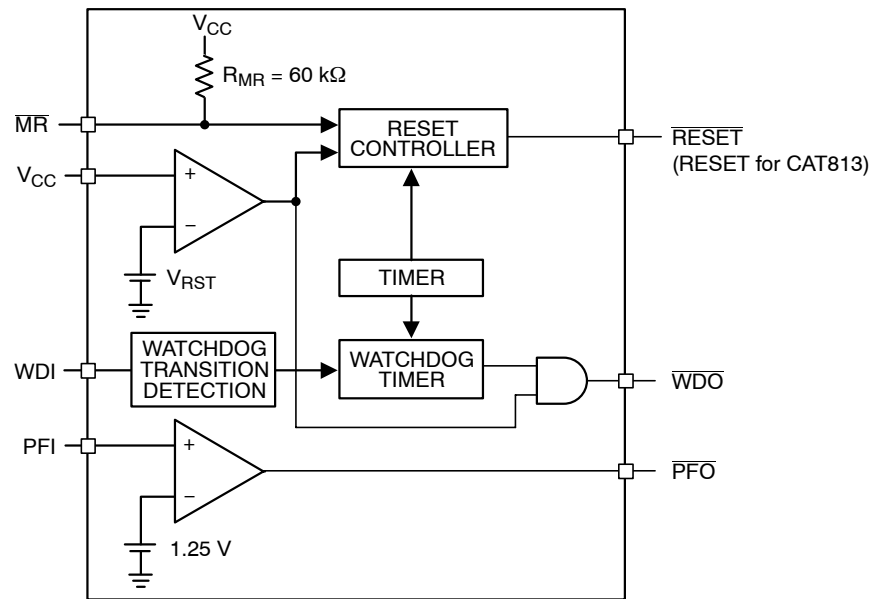
ABRx = Specific Device Code  
(ABRT = CAT705 MSOP)  
(ABRT = CAT706 MSOP)  
(ABRS = CAT813 MSOP)  
Y = Production Year (Last Digit)  
M = Production Month (1-9, O, N, D)  
Z = Product Revision

(\* RESET for CAT813)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

# CAT705, CAT706, CAT813



**Figure 1. Functional Block Diagram**

Device	RESET	RESET	MR	WDI	WDO	PFI
CAT705	@ 4.65 V		x	x	x	@ 1.25 V
CAT706	x		x	x	x	@ 1.25 V
CAT813		@ 4.65 V	x	x	x	@ 1.25 V

# CAT705, CAT706, CAT813

**Table 1. PIN FUNCTION DESCRIPTION**

Pin Name	Function
$\overline{\text{MR}}$	Manual Reset Input
$V_{\text{CC}}$	Power Supply
GND	Ground
PFI	Power Fail voltage monitor Input
$\text{PFO}$	Power Fail Output
WDI	Watchdog Timer Input
$\overline{\text{RESET}}$	CMOS Push–Pull Active Low Reset Output (CAT705 & CAT706)
RESET	CMOS Push–Pull Active High Reset Output (CAT813)
WDO	Watchdog Timer Output

**Table 2. ABSOLUTE MAXIMUM RATINGS**

Parameters	Ratings	Units
Supply Voltage	6.5	V
All other pins	–0.3 to ( $V_{\text{CC}} + 0.3$ )	V
Output Current RESET, $\overline{\text{RESET}}$ , WDO	20	mA
Continuous Power Dissipations ( $T_A = +70^\circ\text{C}$ ) SOIC 8–lead (derate 5.9 mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$ ) MSOP 8–lead (derate 4.1 mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$ )	471 330	mW
Storage Temperature	–65 to 150	$^\circ\text{C}$
Lead Soldering (10 seconds max)	+300	$^\circ\text{C}$
ESD Rating: Human Body Model	2000	V
ESD Rating: Machine Model	200	V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**Table 3. RECOMMENDED OPERATING CONDITIONS**

Parameter	Rating	Unit
$V_{\text{CC}}$ ( $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ )	1.0 to 5.5	V
All Other Pins	–0.1 to ( $V_{\text{CC}} + 0.1$ )	V
Ambient Temperature	–40 to +85	$^\circ\text{C}$

# CAT705, CAT706, CAT813

**Table 4. ELECTRICAL OPERATING CHARACTERISTICS** (Typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5\text{ V}$  for CAT705, CAT706 and CAT813 versions.  $V_{CC} = 3.3\text{ V}$  for the CAT706 T/S versions;  $V_{CC} = 3.0\text{ V}$  for the CAT706 R version.) (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Current	$I_{CC}$	CAT705, CAT706, CAT813		6	17	$\mu\text{A}$
		CAT706 (R/S/T Versions)		4	12	$\mu\text{A}$
Reset Threshold	$V_{RST}$	CAT705 & CAT813 at $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	4.50	4.65	4.75	V
		CAT706 at $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	4.25	4.40	4.50	V
		CAT706T at $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	3.00	3.08	3.15	V
		CAT706S at $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	2.85	2.93	3.00	V
		CAT706R at $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	2.55	2.63	2.70	V
Reset Threshold Tempco (Note 1)				40		ppm/ $^\circ\text{C}$
Reset Threshold Hysteresis (Note 1)		CAT705 & CAT813		10		mV
		CAT706		5		mV
$V_{CC}$ to Reset Delay (Note 2)	$t_{RD}$	$V_{CC} = V_{TH}$ to $(V_{TH} - 100\text{ mV})$		20		$\mu\text{s}$
Reset Active Timeout Period	$t_{RP}$		140	200	400	ms
RESET Output High Voltage	$V_{OH}$	CAT705 & CAT706, $4.5\text{ V} < V_{CC} < 5.5\text{ V}$ , $I_{SOURCE} = -800\text{ }\mu\text{A}$	$V_{CC} - 1.5\text{ V}$			V
		CAT705 & CAT706, $V_{RST(max)} < V_{CC} < 3.6\text{ V}$ , $I_{SOURCE} = -500\text{ }\mu\text{A}$	$0.8 \times V_{CC}$			
RESET Output Low Voltage	$V_{OL}$	CAT705 & CAT706, $4.5\text{ V} < V_{CC} < 5.5\text{ V}$ , $I_{SINK} = 3.2\text{ mA}$			0.4	V
		CAT705 & CAT706, $V_{RST(max)} < V_{CC} < 3.6\text{ V}$ , $I_{SINK} = 1.2\text{ mA}$			0.3	
		CAT705 & CAT706, $V_{CC} = 1\text{ V}$ , $I_{SINK} = 100\text{ }\mu\text{A}$			0.3	
RESET Output High Voltage	$V_{OH}$	CAT813, $V_{CC} = V_{RST max}$ , $I_{SOURCE} = -120\text{ }\mu\text{A}$	$V_{CC} - 1.5\text{ V}$			V
		CAT813, $V_{CC} = V_{RST max}$ , $I_{SOURCE} = -30\text{ }\mu\text{A}$	$0.8 \times V_{CC}$			
RESET Output Low Voltage	$V_{OL}$	CAT813, $V_{CC} = V_{RST min}$ , $I_{SINK} = 3.2\text{ mA}$			0.4	V
		CAT813, $V_{CC} = 1.2\text{ V}$ , $I_{SINK} = 100\text{ }\mu\text{A}$			0.3	

## WATCHDOG INPUT

Watchdog Timeout Period	$t_{WD}$		1.00	1.6	2.25	s
WDI Pulse Width	$t_{WP}$	$V_{IL} = 0.4\text{ V}$ , $V_{IH} = 0.8 \times V_{CC}$	50			ns
WDI Input Voltage (Note 3)	$V_{IL}$				$0.3 \times V_{CC}$	V
	$V_{IH}$		$0.7 \times V_{CC}$			
WDI Input Current (Note 3)		WDI = $V_{CC}$ , Time Average		50	150	$\mu\text{A}$
		WDI = $0\text{ V}$ , Time Average	-150	-50		

1. Limits are guaranteed by design and not production tested.
2. The RESET short-circuit current is the maximum pull-up current when reset is driven low by a bidirectional output.
3. WDI is internally serviced within the watchdog period if WDI is left open.
4. RESET for CAT705 & CAT706 & RESET for CAT813.
5. Not 100% tested but guaranteed by design.

# CAT705, CAT706, CAT813

**Table 4. ELECTRICAL OPERATING CHARACTERISTICS** (Typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5\text{ V}$  for CAT705, CAT706 and CAT813 versions.  $V_{CC} = 3.3\text{ V}$  for the CAT706 T/S versions;  $V_{CC} = 3.0\text{ V}$  for the CAT706 R version.) (Note 1)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>WATCHDOG INPUT</b>						
WDO Output Voltage	$V_{W\_OH}$	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$ ; $I_{SOURCE} = -500\text{ }\mu\text{A}$	$0.8 \times V_{CC}$			V
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$ ; $I_{SOURCE} = -800\text{ }\mu\text{A}$	$V_{CC} - 1.5$	$V_{CC} - 0.25$		
	$V_{W\_OL}$	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$ ; $I_{SINK} = +500\text{ }\mu\text{A}$			0.3	
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$ ; $I_{SINK} = 1.2\text{ mA}$		0.1	0.4	
WDO to WDI setup time (Note 5)	$t_{WDSU}$		250			ns
<b>MANUAL RESET INPUT</b>						
$\overline{MR}$ Input Voltage	$V_{IL}$				$0.3 \times V_{CC}$	V
	$V_{IH}$		$0.7 \times V_{CC}$			
$\overline{MR}$ Pull-up Current		$\overline{MR} = 0\text{ V}$	40	70	140	$\mu\text{A}$
$\overline{MR}$ Pulse Width	$t_{PB}$		1			$\mu\text{s}$
$\overline{MR}$ Pull-up Resistance	$R_{MR}$		40	60	80	$\text{k}\Omega$
$\overline{MR}$ low to Reset Delay (Note 4)	$t_{PDLY}$				5	$\mu\text{s}$
<b>POWER-FAIL INPUT</b>						
PFI Input Threshold		$V_{CC} = 5\text{ V}$	1.2	1.25	1.3	V
PFI Input Current			-25	0.01	25	nA
$\overline{PFO}$ Output Voltage	$V_{P\_OH}$	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$ ; $I_{SOURCE} = -500\text{ }\mu\text{A}$	$0.8 \times V_{CC}$			V
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$ ; $I_{SOURCE} = -800\text{ }\mu\text{A}$	$V_{CC} - 1.5$		0.4	
	$V_{P\_OL}$	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$ ; $I_{SINK} = +1.2\text{ mA}$			0.3	
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$ , $I_{SINK} = 3.2\text{ mA}$			0.4	

1. Limits are guaranteed by design and not production tested.
2. The RESET short-circuit current is the maximum pull-up current when reset is driven low by a bidirectional output.
3. WDI is internally serviced within the watchdog period if WDI is left open.
4. RESET for CAT705 & CAT706 & RESET for CAT813.
5. Not 100% tested but guaranteed by design.

## TYPICAL PERFORMANCE CHARACTERISTICS

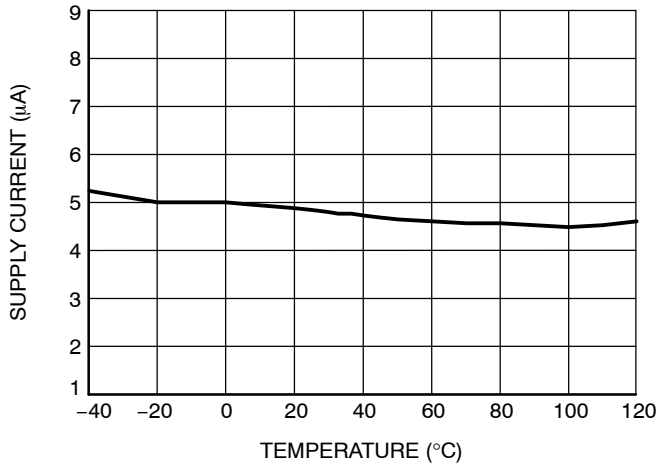


Figure 2.  $V_{CC}$  Supply Current vs. Temperature

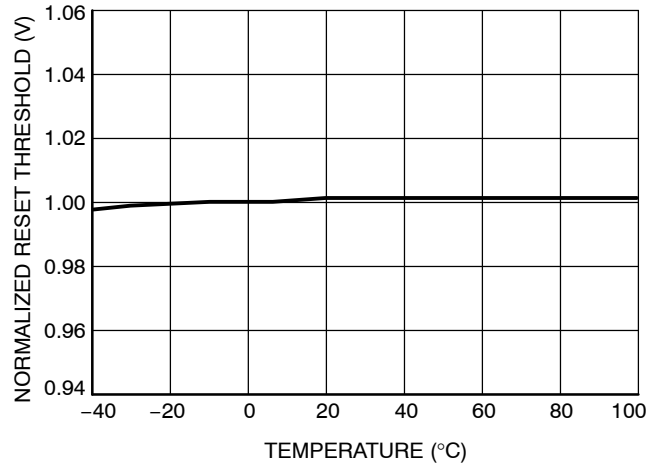


Figure 3. Normalized Reset Threshold Voltage vs. Temperature

## FUNCTIONAL DESCRIPTION

### Processor Reset

The CAT705, CAT706 & CAT813 detect supply voltage ( $V_{CC}$ ) conditions that are below the specified voltage trip value ( $V_{RST}$ ) and provide a reset output to maintain correct system operation. On power-up,  $\overline{RESET}$  (or RESET for the CAT813) are kept active for a minimum delay  $t_{RP}$  of 140 ms after the supply voltage ( $V_{CC}$ ) rises above  $V_{RST}$  to allow the power supply and processor to stabilize. When  $V_{CC}$  drops below the voltage trip value ( $V_{RST}$ ), the reset output signals  $\overline{RESET}$  (or RESET) are pulled active.  $\overline{RESET}$  (or RESET) is specifically designed to provide the reset input signals for processors. This provides reliable and consistent operation as power is turned on, off or during brownout conditions by maintaining the processor operation in known conditions.

### Manual Reset

The CAT705, CAT706 & CAT813 each have a Manual Reset ( $\overline{MR}$ ) input to allow for alternative control of the reset outputs. The  $\overline{MR}$  input is designed for direct connection to a pushbutton (see Figure 4). The  $\overline{MR}$  input is internally pulled up by 60 k $\Omega$  resistor and must be pulled low to cause the reset output to go active. Internally, this input is debounced and timed such that  $\overline{RESET}$  (or RESET) signals of at least 140 ms minimum will be generated. The min 140 ms  $t_{RP}$  delay commences as the Manual Reset input is released from the low level. (see Figure 5).

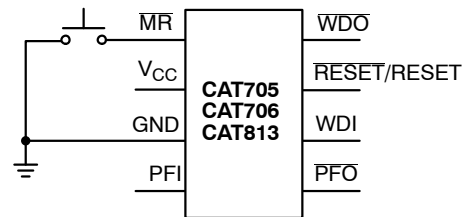


Figure 4. Pushbutton RESET

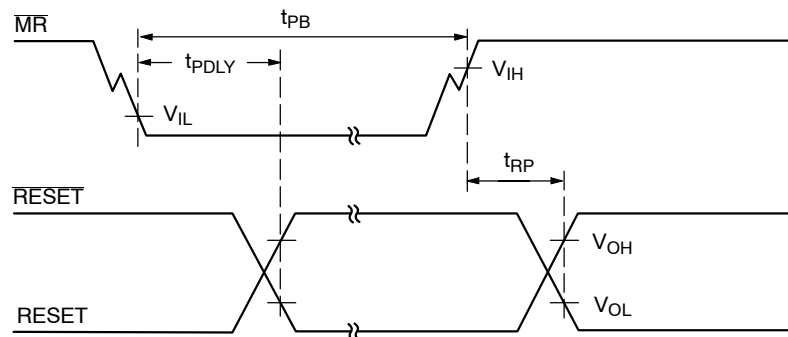


Figure 5. Timing Diagram – Pushbutton RESET

## WATCHDOG TIMER

The CAT705, CAT706, & CAT813 provide a Watchdog input (WDI). The watchdog timer function controls the watchdog output ( $\overline{\text{WDO}}$ ) signal and forces the  $\overline{\text{WDO}}$  to be low (active) when the WDI input does not have a transition from low-to-high or high-to-low within 1.6 s typical. If a transition occurs on the WDI input pin prior to the watchdog time-out, the watchdog timer is restarted. The timing diagram is shown in Figure 6. The watchdog timer starts as soon as reset condition becomes inactive.

When the  $V_{CC}$  supply drops below the reset threshold, the  $\overline{\text{WDO}}$  output becomes active and goes low independently of the watchdog timing stage.

Figure 7 below shows a typical implementation of a watchdog function. Any processor signal that repeats dependant on the normal operation of the processor or directed by the software operating on the processor can be

used to strobe the watchdog input. The most reliable is a dedicated I/O output transitioned by a specific software instruction.

The watchdog can be disabled by floating (or tri-stating) the WDI input (see Figure 8). If the watchdog is disabled the WDI pin will be pulled low for the first  $7/8^{\text{th}}$ 's of the watchdog period ( $t_{WD}$ ) and pulled high for the last  $1/8^{\text{th}}$  of the watchdog period. This pulling low of the WDI input and then high is used to detect an open or tri-state condition and will continue to repeat until the WDI input is driven high or low.

For most efficient operation of devices with the watchdog function the WDI input should be held low the majority of the time and only strobed high as required to reset the watchdog timer.

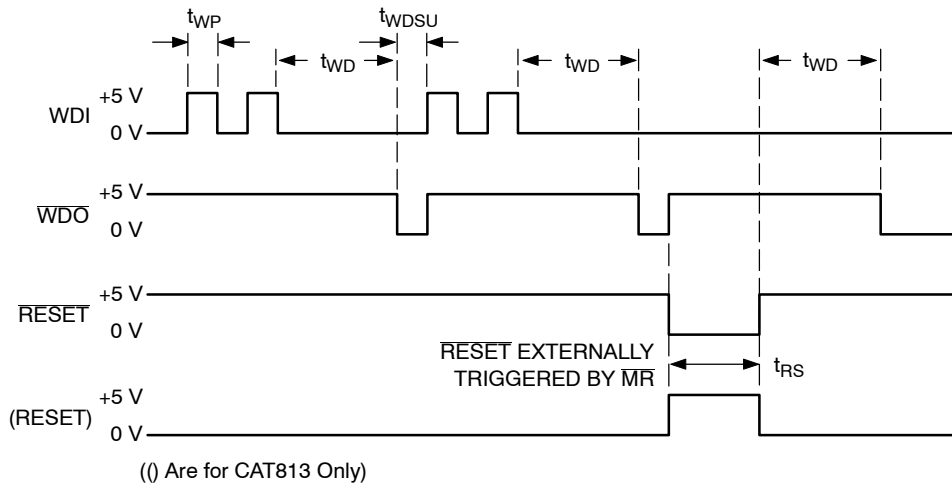


Figure 6. Watchdog Timing Diagram

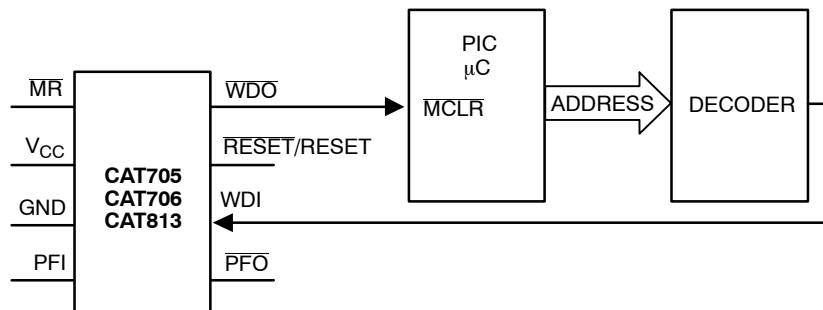


Figure 7. Watchdog Timer Circuit

## CAT705, CAT706, CAT813

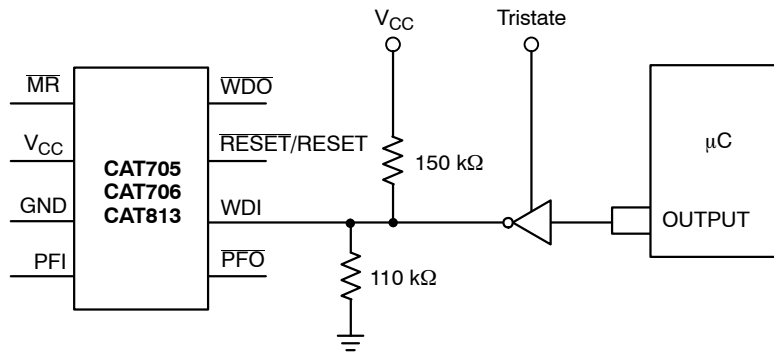


Figure 8. Watchdog Disable Circuit

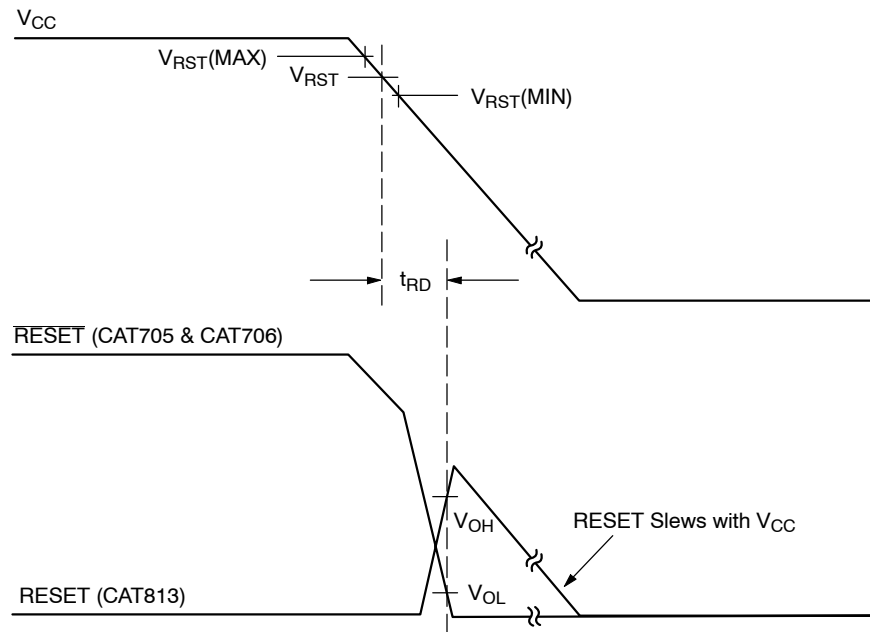


Figure 9. Timing Diagram – Power Down

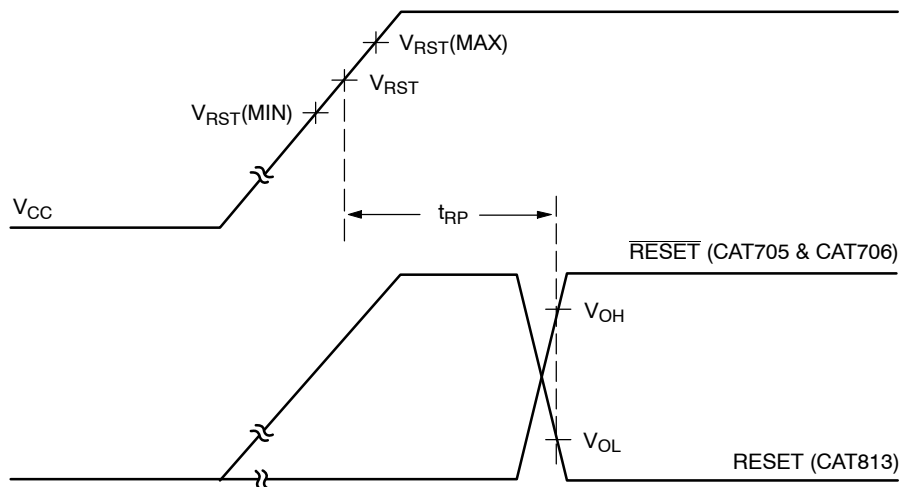


Figure 10. Timing Diagram – Power Up



# CAT705, CAT706, CAT813

## APPLICATION NOTES

### μP's with Bidirectional Reset Pins

The  $\overline{\text{RESET}}$  output can be pulled low by processors like the 68HC11 allowing for a system reset issued by the processor. The maximum pullup current that can be sourced by the CAT705 & CAT706 1.5 mA (and by the CAT706 T/R/S is 800  $\mu\text{A}$ ) allowing the processor to pull the output low even when the CAT70x is pulling it high.

### Power Transients

Generally short duration negative-going transients of less than 2  $\mu\text{s}$  on the power supply at  $V_{\text{RST}}$  minimum will not cause a reset condition. However the lower the voltage of the transient the shorter the required time to cause a reset output.

These issues can usually be remedied by the proper location of bypass capacitance on the circuit board.

### Output Valid Conditions

The  $\overline{\text{RESET}}$  output uses a push-pull output which can maintain a valid output down to a  $V_{\text{CC}}$  of 1.0 volts. To sink current below 0.8 V a resistor can be connected from  $\overline{\text{RESET}}$  to Ground (see Figure 11.) This arrangement will maintain a valid value on the  $\overline{\text{RESET}}$  output during both power up and down but will draw current when the  $\overline{\text{RESET}}$  output is in the high state. A resistor value of about 100 k $\Omega$  should be adequate in most situations to maintain a low condition valid output down to  $V_{\text{CC}}$  equal to 1.0 V.

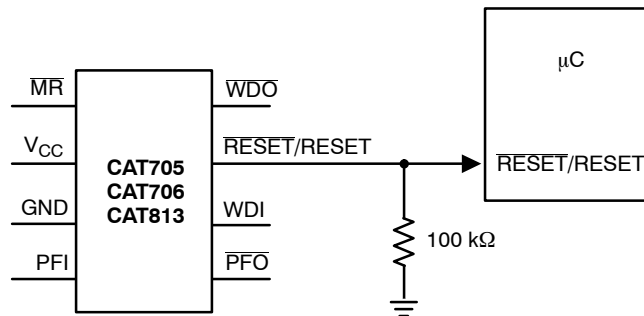


Figure 11. RESET Valid for  $V_{\text{CC}} < 1.0 \text{ V}$

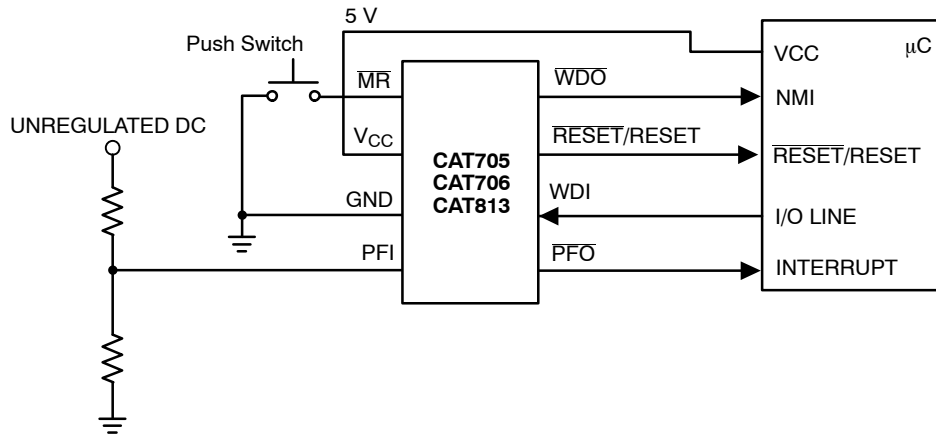
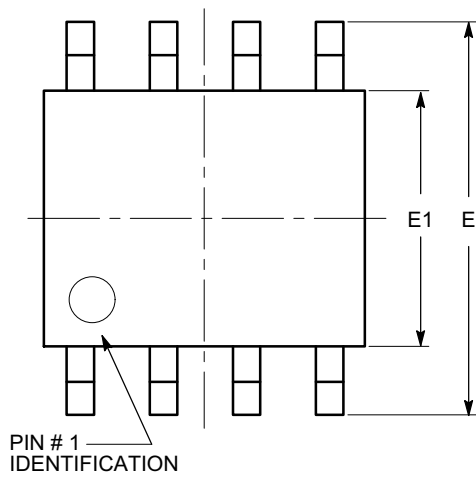


Figure 12. Typical Operating Circuit

# CAT705, CAT706, CAT813

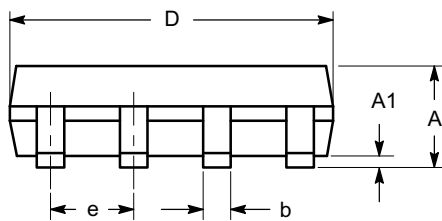
## PACKAGE DIMENSIONS

SOIC 8, 150 mils  
CASE 751BD-01  
ISSUE O

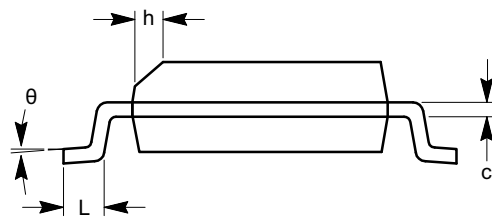


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	4.80		5.00
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
$\theta$	0°		8°



SIDE VIEW



END VIEW

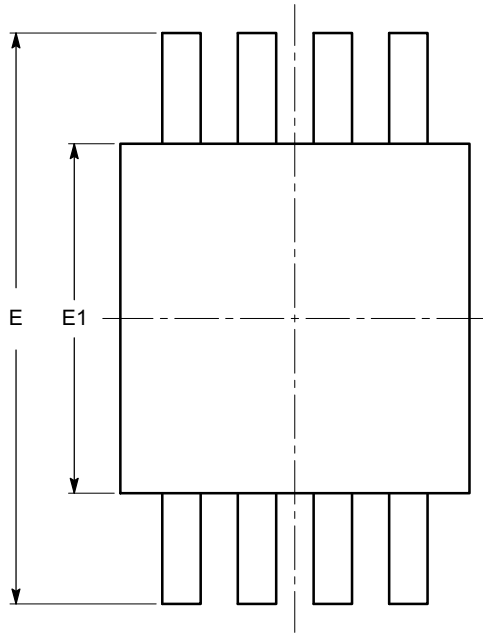
### Notes:

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

# CAT705, CAT706, CAT813

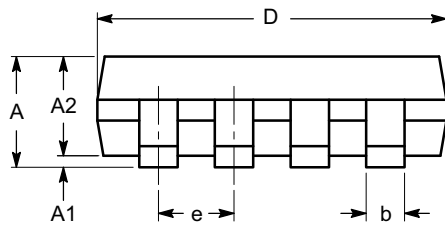
## PACKAGE DIMENSIONS

MSOP 8, 3x3  
CASE 846AD-01  
ISSUE O

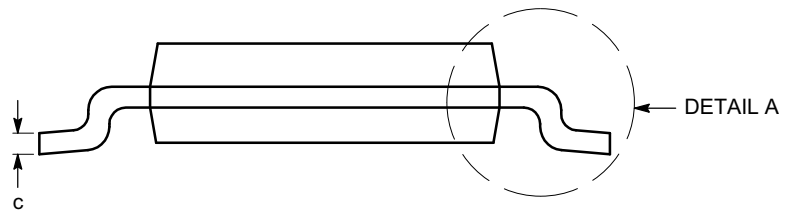


TOP VIEW

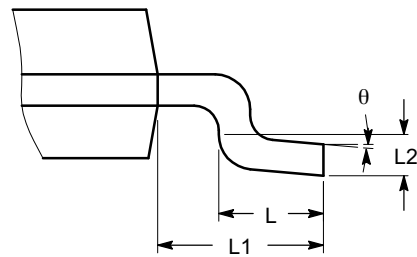
SYMBOL	MIN	NOM	MAX
A			1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
b	0.22		0.38
c	0.13		0.23
D	2.90	3.00	3.10
E	4.80	4.90	5.00
E1	2.90	3.00	3.10
e	0.65 BSC		
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
$\theta$	0°		6°



SIDE VIEW



END VIEW



DETAIL A

### Notes:


- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-187.

# CAT705, CAT706, CAT813

## Example of Ordering Information (Notes 6 – 8)

Order Number	Voltage	Top Mark	Manual Reset	Reset Output	Package	Quantity per Reel (Note 9)
CAT705VI-GT3	4.65	CAT705V	Yes	LOW	SOIC-8	3,000
CAT705ZI-GT3		ABRT			MSOP-8	
CAT706RVI-GT3	2.63	CAT706V	Yes	LOW	SOIC-8	
CAT706RZI-GT3		ABRT			MSOP-8	
CAT706SVI-GT3	2.93	CAT706V	Yes	LOW	SOIC-8	
CAT706SZI-GT3		ABRT			MSOP-8	
CAT706TVI-GT3	3.08	CAT706V	Yes	LOW	SOIC-8	
CAT706TZI-GT3		ABRT			MSOP-8	
CAT706VI-GT3	4.40	CAT706V	Yes	LOW	SOIC-8	
CAT706ZI-GT3		ABRT			MSOP-8	
CAT813VI-GT3	4.65	CAT813V	Yes	HIGH	SOIC-8	
CAT813ZI-GT3		ABRS			MSOP-8	

6. All packages are RoHS-compliant (Lead-free, Halogen-free).
7. The standard lead finish is NiPdAu.
8. Contact factory for package availability.
9. For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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