

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 μA 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 $-40^{\circ}C$ to $+85^{\circ}C$
- 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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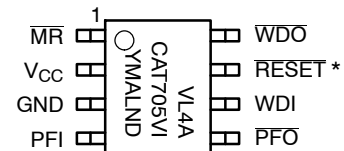
SOIC-8
V SUFFIX
CASE 751BD



MSOP-8
Z SUFFIX
CASE 846AD

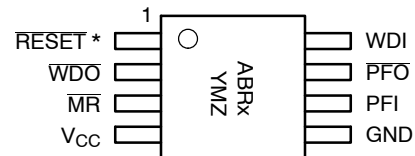
PIN CONFIGURATIONS AND MARKING DIAGRAMS

SOIC-8 (V) (Top View)



- V = Threshold Voltages
(Blank = 4.65 V, T = 3.08 V,
S = 2.93 V, R = 2.63 V)
- 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

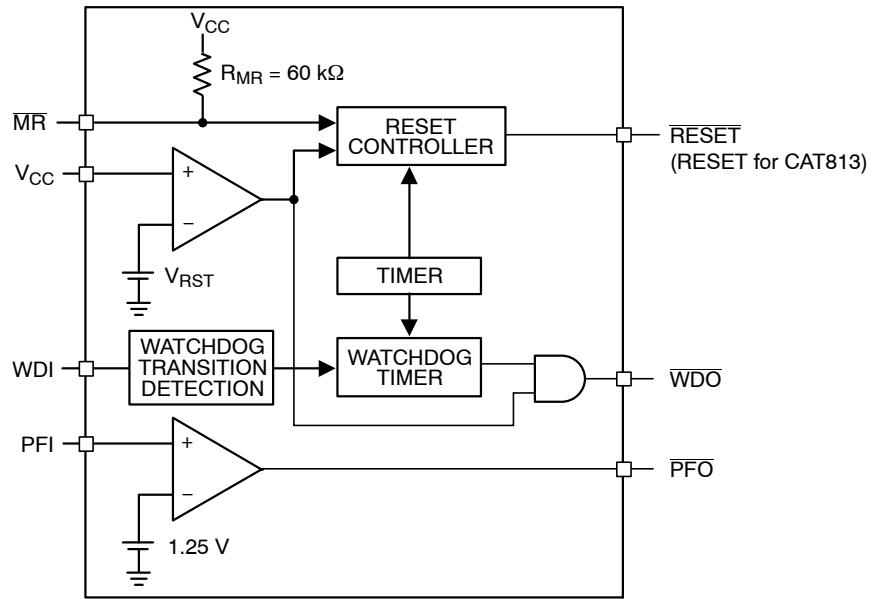


Figure 1. Functional Block Diagram

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_{CC}	Power Supply
GND	Ground
PFI	Power Fail voltage monitor Input
$\overline{\text{PFO}}$	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_{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	μA
		CAT706 (R/S/T Versions)		4	12	μA
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
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		μs
Reset Active Timeout Period	t_{RP}		140	200	400	ms
RESE \overline{T} Output High Voltage	V_{OH}	CAT705 & CAT706, $4.5\text{ V} < V_{CC} < 5.5\text{ V}$, $I_{SOURCE} = -800\ \mu\text{A}$	$V_{CC} - 1.5\text{ V}$			V
		CAT705 & CAT706, $V_{RST(max)} < V_{CC} < 3.6\text{ V}$, $I_{SOURCE} = -500\ \mu\text{A}$	$0.8 \times V_{CC}$			
RESE \overline{T} 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, $V_{CC} = 1\text{ V}$, $I_{SINK} = 100\ \mu\text{A}$			0.3	
RESE \overline{T} Output High Voltage	V_{OH}	CAT813, $V_{CC} = V_{RST max}$, $I_{SOURCE} = -120\ \mu\text{A}$	$V_{CC} - 1.5\text{ V}$			V
		CAT813, $V_{CC} = V_{RST max}$, $I_{SOURCE} = -30\ \mu\text{A}$	$0.8 \times V_{CC}$			
RESE \overline{T} Output Low Voltage	V_{OL}	CAT813, $V_{CC} = V_{RST min}$, $I_{SINK} = 3.2\text{ mA}$			0.4	V
		CAT813, $V_{CC} = 1.2\text{ V}$, $I_{SINK} = 100\ \mu\text{A}$			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	μA
		WDI = 0 V , Time Average	-150	-50		

1. Limits are guaranteed by design and not production tested.
2. The RESE \overline{T} 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. RESE \overline{T} for CAT705 & CAT706 & RESE \overline{T} 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
WATCHDOG INPUT						
WDO Output Voltage	V_{W_OH}	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$; $I_{SOURCE} = -500\ \mu\text{A}$	$0.8 \times V_{CC}$			V
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$; $I_{SOURCE} = -800\ \mu\text{A}$	$V_{CC} - 1.5$	$V_{CC} - 0.25$		
	V_{W_OL}	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$; $I_{SINK} = +500\ \mu\text{A}$			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
MANUAL RESET INPUT						
\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	μA
\overline{MR} Pulse Width	t_{PB}		1			μs
\overline{MR} Pull-up Resistance	R_{MR}		40	60	80	$\text{k}\Omega$
\overline{MR} low to Reset Delay (Note 4)	t_{PDLY}				5	μs
POWER-FAIL INPUT						
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}	$V_{RST(max)} < V_{CC} < 3.6\text{ V}$; $I_{SOURCE} = -500\ \mu\text{A}$	$0.8 \times V_{CC}$			V
		$4.5\text{ V} < V_{CC} < 5.5\text{ V}$; $I_{SOURCE} = -800\ \mu\text{A}$	$V_{CC} - 1.5$		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.

CAT705, CAT706, CAT813

TYPICAL PERFORMANCE CHARACTERISTICS

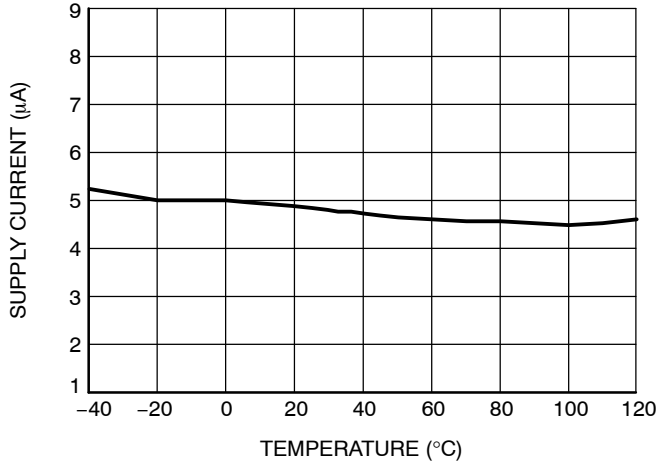


Figure 2. V_{CC} Supply Current vs. Temperature

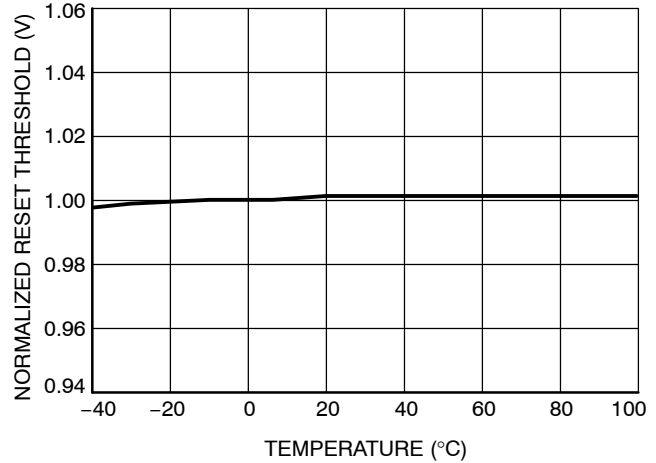


Figure 3. Normalized Reset Threshold Voltage vs. Temperature

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 Ω 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).

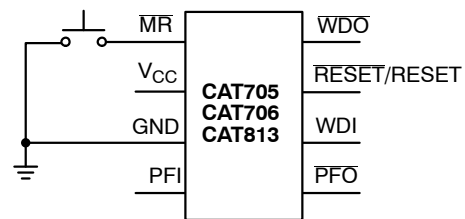


Figure 4. Pushbutton RESET

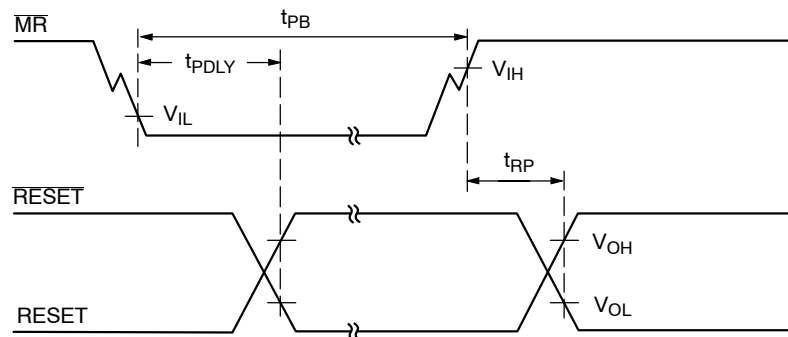


Figure 5. Timing Diagram – Pushbutton RESET

WATCHDOG TIMER

The CAT705, CAT706, & CAT813 provide a Watchdog input (WDI). The watchdog timer function controls the watchdog output (\overline{WDO}) signal and forces the \overline{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{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 $7/8^{th}$'s of the watchdog period (t_{WD}) and pulled high for the last $1/8^{th}$ 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.

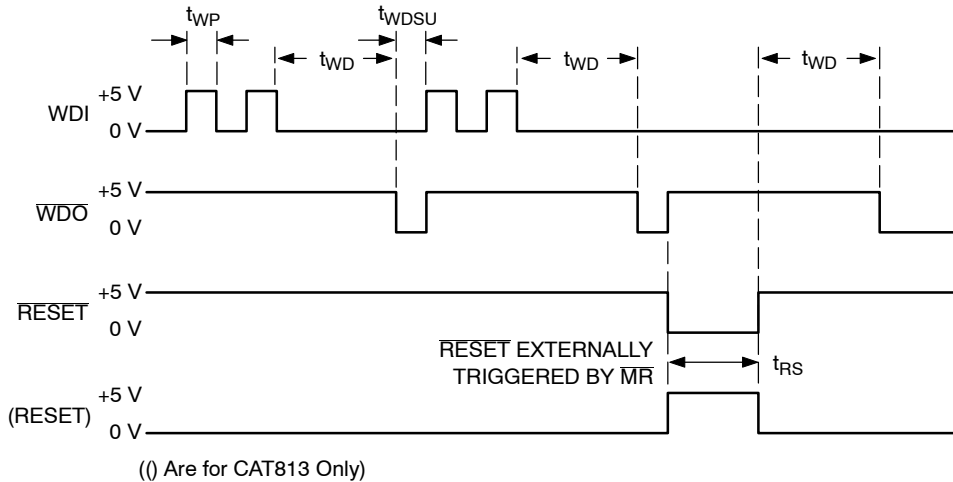


Figure 6. Watchdog Timing Diagram

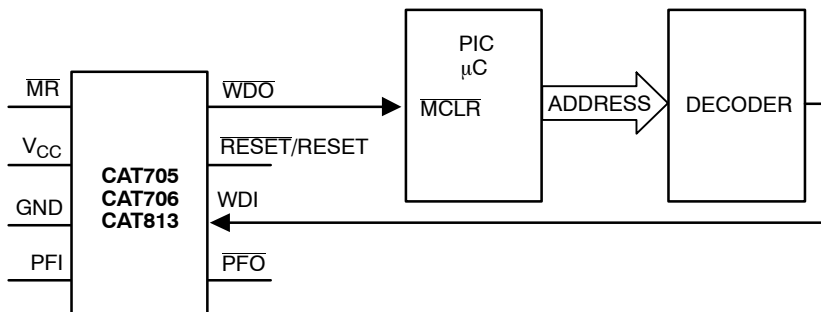


Figure 7. Watchdog Timer Circuit

CAT705, CAT706, CAT813

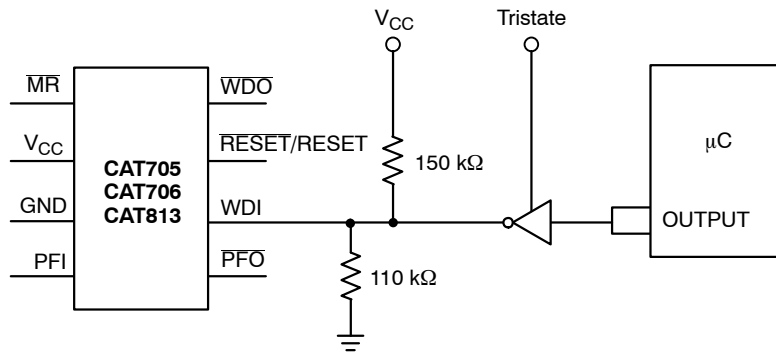


Figure 8. Watchdog Disable Circuit

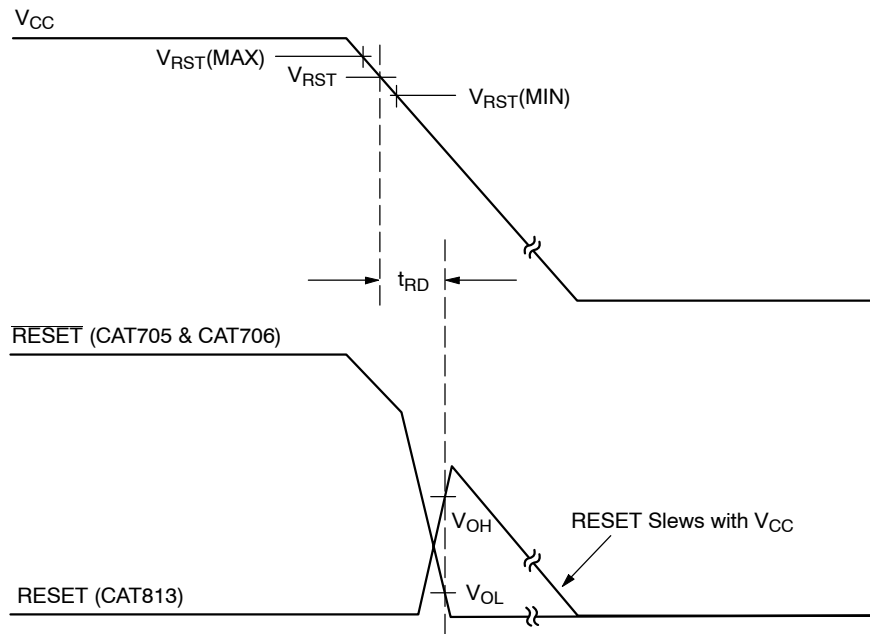


Figure 9. Timing Diagram – Power Down

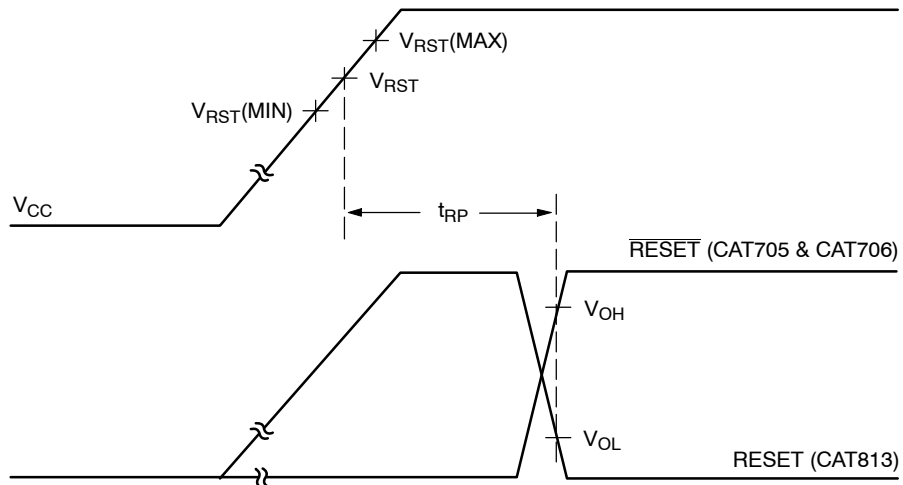


Figure 10. Timing Diagram – Power Up

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 μA) 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 μs on the power supply at V_{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_{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 Ω should be adequate in most situations to maintain a low condition valid output down to V_{CC} equal to 1.0 V.

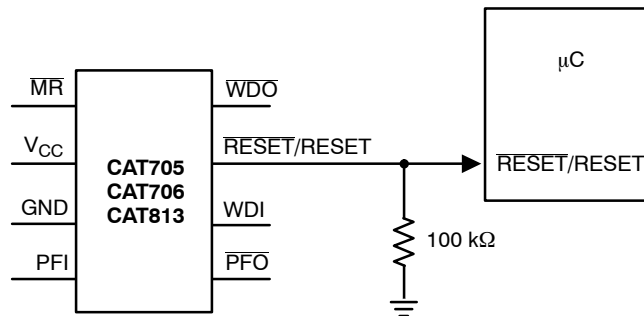


Figure 11. $\overline{\text{RESET}}$ Valid for $V_{\text{CC}} < 1.0 \text{ V}$

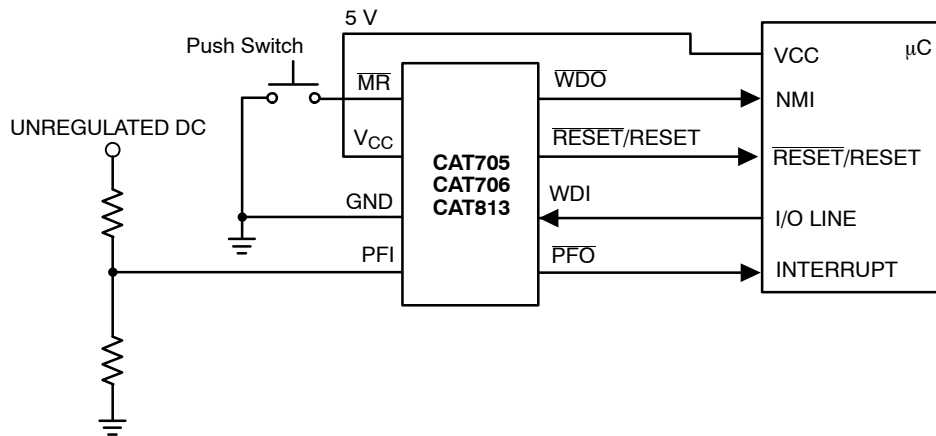
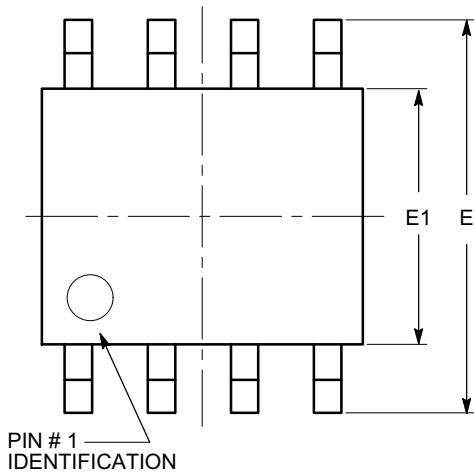


Figure 12. Typical Operating Circuit

CAT705, CAT706, CAT813

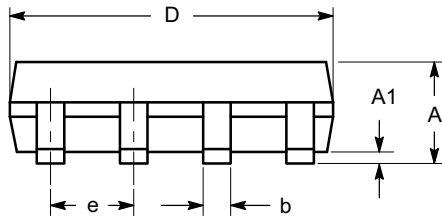
PACKAGE DIMENSIONS

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

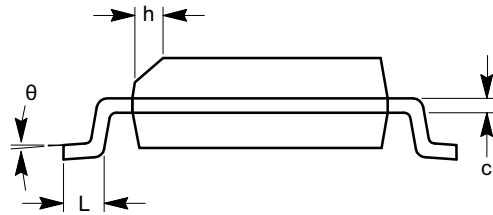


TOP VIEW

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
θ	0°		8°



SIDE VIEW



END VIEW

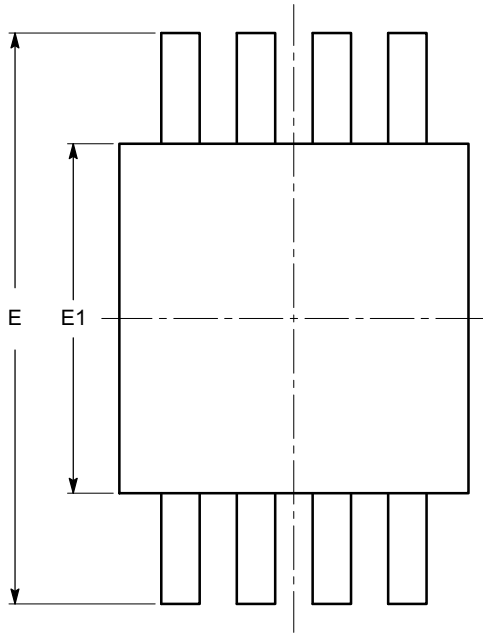
Notes:

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

CAT705, CAT706, CAT813

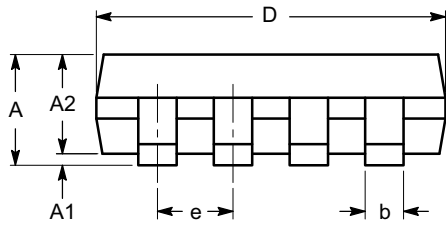
PACKAGE DIMENSIONS

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

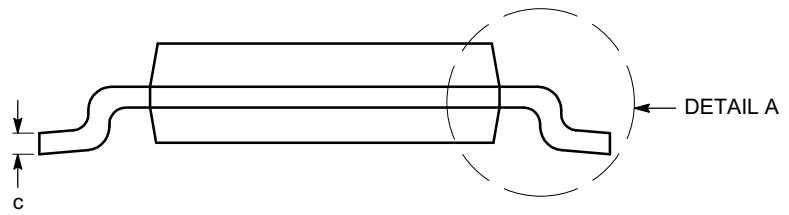


TOP VIEW

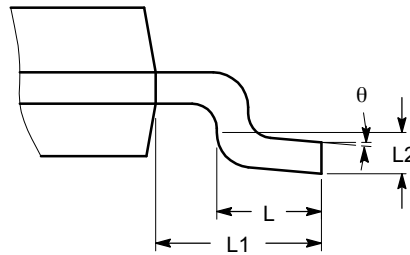
SYMBOL	MIN	NOM	MAX
A			1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
b	0.22		0.38
c	0.13		0.23
D	2.90	3.00	3.10
E	4.80	4.90	5.00
E1	2.90	3.00	3.10
e	0.65 BSC		
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
θ	0°		6°



SIDE VIEW



END VIEW



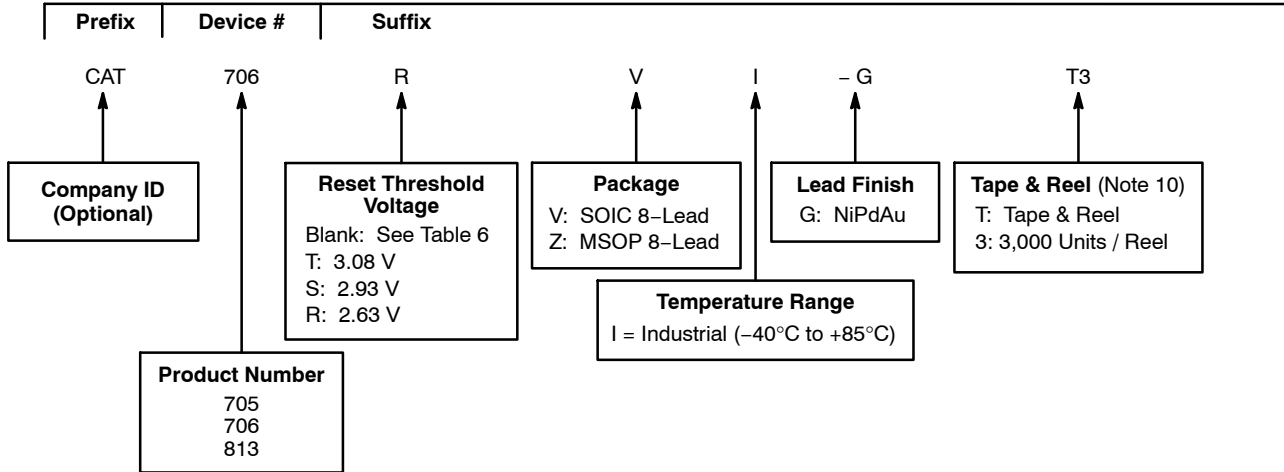
DETAIL A

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 – 9)



- All packages are RoHS-compliant (Lead-free, Halogen-free).
- The standard lead finish is NiPdAu.
- The device used in the above example is a CAT706RVI-GT3 (2.63 V, SOIC 8-Lead, Industrial Temperature, NiPdAu, Tape & Reel, 3,000/Reel).
- Contact factory for package availability.
- 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.

Table 5. TOP MARKING INFORMATION (For All Thresholds)

Device #	Package	Top Marking
NiPdAu FINISH (-G)		
CAT705	MSOP	ABRT
CAT706	MSOP	ABRT
CAT813	MSOP	ABRS
CAT705	SOIC	CAT705V
CAT706	SOIC	CAT706V
CAT813	SOIC	CAT813V

Table 6. ORDERING PART NUMBER

Order Part Number	Threshold Voltage
CAT705VI-G	4.65 V
CAT705ZI-G	
CAT706VI-G	4.40 V
CAT706ZI-G	
CAT706RVI-G	2.63 V
CAT706RZI-G	
CAT706SVI-G	2.93 V
CAT706SZI-G	
CAT706TVI-G	3.08 V
CAT706TZI-G	
CAT813VI-G	4.65 V
CAT813ZI-G	

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