

## Description

The GM5510 series are highly precise and low power consumption voltage detectors. Manufactured by using CMOS and laser trimming technologies. Detect voltage is extremely accurate with minimal temperature drift. Both CMOS and N-channel open drain output configurations are available.

## Features

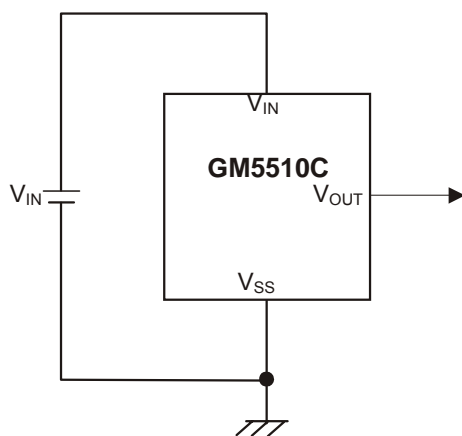
- ◆ **Highly accurate:**  $\pm 2\%$
- ◆ **Low power consumption:** TYP  $0.7\mu\text{A}$  ( $V_{\text{IN}} = 1.5\text{V}$ )
- ◆ **Detect voltage range:** 1.6V to 6.0V in 0.1V increments
- ◆ **Operating voltage range:** 0.7 to 10.0V
- ◆ **Detect voltage temperature characteristic:** TYP  $\pm 100 \text{ ppm}/^\circ\text{C}$
- ◆ **Output Configuration:** CMOS or N channel open drain

## Application

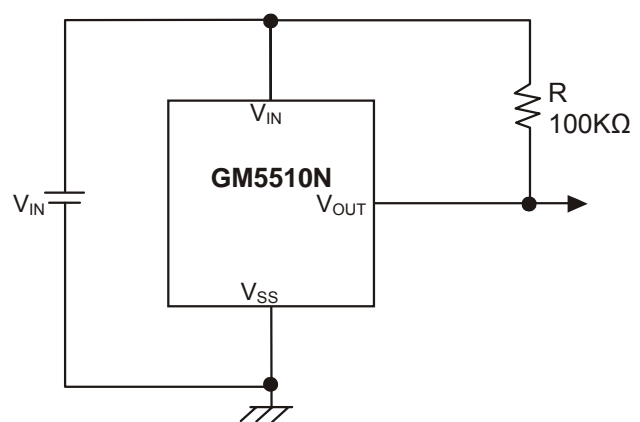
Microprocessor reset circuitry  
Memory battery back-up circuits  
Power-on reset circuits

Power failure detection  
System battery life and charge voltage monitors

## Typical Application Circuits



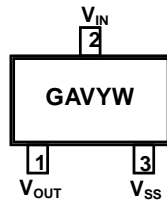
CMOS Output



N-CH Open Drain Output

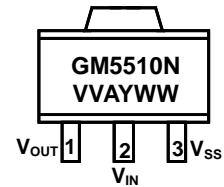
## Marking Information and Pin Configurations (Top View)

SOT23

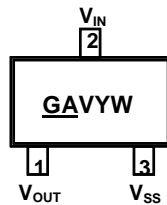


GA: GM5510N, N-CH Open Drain  
 V: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 W: Week Code

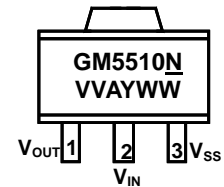
SOT89



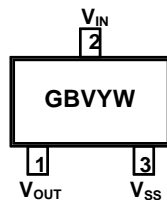
N: N-CH Open Drain  
 VV: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 WW: Week



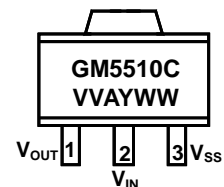
GA: GM5510N, N-CH Open Drain, Green Product  
 V: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 W: Week Code



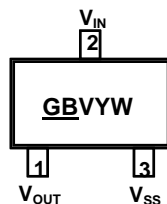
N: N-CH Open Drain, Green Product  
 VV: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 WW: Week



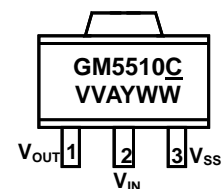
GA: GM5510C, CMOS  
 V: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 W: Week Code



C: CMOS,  
 VV: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 WW: Week



GB: GM5510C, CMOS, Green Product  
 V: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 W: Week Code



C: CMOS, Green Product  
 VV: Detect Voltage (See "Voltage Suffix" table)  
 Y: Year  
 WW: Week

## Ordering Information – Pb Free Products

Ordering Number	Output Configuration	Detect Voltage	Voltage Suffix	Package	Shipping
GM5510C-1.8ST23R	CMOS	1.8V	C	SOT-23	3,000 Units / Reel
GM5510C-2.0ST23R	CMOS	2.0V	E	SOT-23	3,000 Units / Reel
GM5510C-2.7ST23R	CMOS	2.7V	K	SOT-23	3,000 Units / Reel
GM5510C-2.9ST23R	CMOS	2.9V	M	SOT-23	3,000 Units / Reel
GM5510C-2.93ST23R	CMOS	2.93V	S	SOT-23	3,000 Units / Reel
GM5510C-3.0ST23R	CMOS	3.0V	N	SOT-23	3,000 Units / Reel
GM5510C-3.08ST23R	CMOS	3.08V	P	SOT-23	3,000 Units / Reel
GM5510C-3.3ST23R	CMOS	3.3V	Q	SOT-23	3,000 Units / Reel
GM5510C-3.6ST23R	CMOS	3.6V	T	SOT-23	3,000 Units / Reel
GM5510C-4.0ST23R	CMOS	4.0V	X	SOT-23	3,000 Units / Reel
GM5510C-4.1ST23R	CMOS	4.1V	Y	SOT-23	3,000 Units / Reel
GM5510C-4.2ST23R	CMOS	4.2V	Z	SOT-23	3,000 Units / Reel
GM5510C-1.8ST89R	CMOS	1.8V	18	SOT89	1,000 Units / Reel
GM5510C-2.0ST89R	CMOS	2.0V	20	SOT89	1,000 Units / Reel
GM5510C-2.7ST89R	CMOS	2.7V	27	SOT89	1,000 Units / Reel
GM5510C-2.9ST89R	CMOS	2.9V	29	SOT89	1,000 Units / Reel
GM5510C-3.0ST89R	CMOS	3.0V	30	SOT89	1,000 Units / Reel
GM5510C-3.08ST89R	CMOS	3.08V	31	SOT89	1,000 Units / Reel
GM5510C-3.3ST89R	CMOS	3.3V	33	SOT89	1,000 Units / Reel
GM5510C-3.6ST89R	CMOS	3.6V	36	SOT89	1,000 Units / Reel
GM5510C-4.0ST89R	CMOS	4.0V	40	SOT89	1,000 Units / Reel
GM5510C-4.1ST89R	CMOS	4.1V	41	SOT89	1,000 Units / Reel
GM5510C-4.2ST89R	CMOS	4.2V	42	SOT89	1,000 Units / Reel

## Ordering Information – Pb Free Products (continued)

Ordering Number	Output Configuration	Detect Voltage	Voltage Suffix	Package	Shipping
GM5510N-1.8ST23R	N-CH Open Drain	1.8V	C	SOT-23	3,000 Units / Reel
GM5510N-2.0ST23R	N-CH Open Drain	2.0V	E	SOT-23	3,000 Units / Reel
GM5510N-2.7ST23R	N-CH Open Drain	2.7V	K	SOT-23	3,000 Units / Reel
GM5510N-2.9ST23R	N-CH Open Drain	2.9V	M	SOT-23	3,000 Units / Reel
GM5510N-2.93ST23R	N-CH Open Drain	2.93V	S	SOT-23	3,000 Units / Reel
GM5510N-3.0ST23R	N-CH Open Drain	3.0V	N	SOT-23	3,000 Units / Reel
GM5510N-3.08ST23R	N-CH Open Drain	3.08V	P	SOT-23	3,000 Units / Reel
GM5510N-3.3ST23R	N-CH Open Drain	3.3V	Q	SOT-23	3,000 Units / Reel
GM5510N-3.6ST23R	N-CH Open Drain	3.6V	T	SOT-23	3,000 Units / Reel
GM5510N-4.0ST23R	N-CH Open Drain	4.0V	X	SOT-23	3,000 Units / Reel
GM5510N-4.1ST23R	N-CH Open Drain	4.1V	Y	SOT-23	3,000 Units / Reel
GM5510N-4.2ST23R	N-CH Open Drain	4.2V	Z	SOT-23	3,000 Units / Reel
GM5510N-1.8ST89R	N-CH Open Drain	1.8V	18	SOT89	1,000 Units / Reel
GM5510N-2.0ST89R	N-CH Open Drain	2.0V	20	SOT89	1,000 Units / Reel
GM5510N-2.7ST89R	N-CH Open Drain	2.7V	27	SOT89	1,000 Units / Reel
GM5510N-2.9ST89R	N-CH Open Drain	2.9V	29	SOT89	1,000 Units / Reel
GM5510N-3.0ST89R	N-CH Open Drain	3.0V	30	SOT89	1,000 Units / Reel
GM5510N-3.08ST89R	N-CH Open Drain	3.08V	31	SOT89	1,000 Units / Reel
GM5510N-3.3ST89R	N-CH Open Drain	3.3V	33	SOT89	1,000 Units / Reel
GM5510N-3.6ST89R	N-CH Open Drain	3.6V	36	SOT89	1,000 Units / Reel
GM5510N-4.0ST89R	N-CH Open Drain	4.0V	40	SOT89	1,000 Units / Reel
GM5510N-4.1ST89R	N-CH Open Drain	4.1V	41	SOT89	1,000 Units / Reel
GM5510N-4.2ST89R	N-CH Open Drain	4.2V	42	SOT89	1,000 Units / Reel

## Ordering Information – Green Products

Ordering Number	Output Configuration	Detect Voltage	Voltage Suffix	Package	Shipping
GM5510C-1.8ST23RG	CMOS	1.8V	C	SOT-23	3,000 Units / Reel
GM5510C-2.0ST23RG	CMOS	2.0V	E	SOT-23	3,000 Units / Reel
GM5510C-2.7ST23RG	CMOS	2.7V	K	SOT-23	3,000 Units / Reel
GM5510C-2.9ST23RG	CMOS	2.9V	M	SOT-23	3,000 Units / Reel
GM5510C-2.93ST23RG	CMOS	2.93V	S	SOT-23	3,000 Units / Reel
GM5510C-3.0ST23RG	CMOS	3.0V	N	SOT-23	3,000 Units / Reel
GM5510C-3.08ST23RG	CMOS	3.08V	P	SOT-23	3,000 Units / Reel
GM5510C-3.3ST23RG	CMOS	3.3V	Q	SOT-23	3,000 Units / Reel
GM5510C-3.6ST23RG	CMOS	3.6V	T	SOT-23	3,000 Units / Reel
GM5510C-4.0ST23RG	CMOS	4.0V	X	SOT-23	3,000 Units / Reel
GM5510C-4.1ST23RG	CMOS	4.1V	Y	SOT-23	3,000 Units / Reel
GM5510C-4.2ST23RG	CMOS	4.2V	Z	SOT-23	3,000 Units / Reel
GM5510C-1.8ST89RG	CMOS	1.8V	18	SOT89	1,000 Units / Reel
GM5510C-2.0ST89RG	CMOS	2.0V	20	SOT89	1,000 Units / Reel
GM5510C-2.7ST89RG	CMOS	2.7V	27	SOT89	1,000 Units / Reel
GM5510C-2.9ST89RG	CMOS	2.9V	29	SOT89	1,000 Units / Reel
GM5510C-3.0ST89RG	CMOS	3.0V	30	SOT89	1,000 Units / Reel
GM5510C-3.08ST89RG	CMOS	3.08V	31	SOT89	1,000 Units / Reel
GM5510C-3.3ST89RG	CMOS	3.3V	33	SOT89	1,000 Units / Reel
GM5510C-3.6ST89RG	CMOS	3.6V	36	SOT89	1,000 Units / Reel
GM5510C-4.0ST89RG	CMOS	4.0V	40	SOT89	1,000 Units / Reel
GM5510C-4.1ST89RG	CMOS	4.1V	41	SOT89	1,000 Units / Reel
GM5510C-4.2ST89RG	CMOS	4.2V	42	SOT89	1,000 Units / Reel

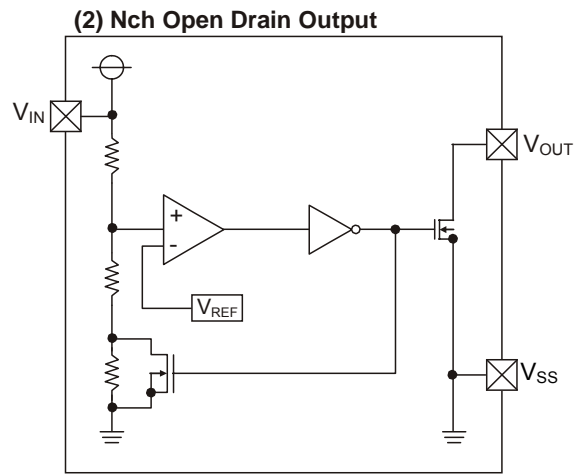
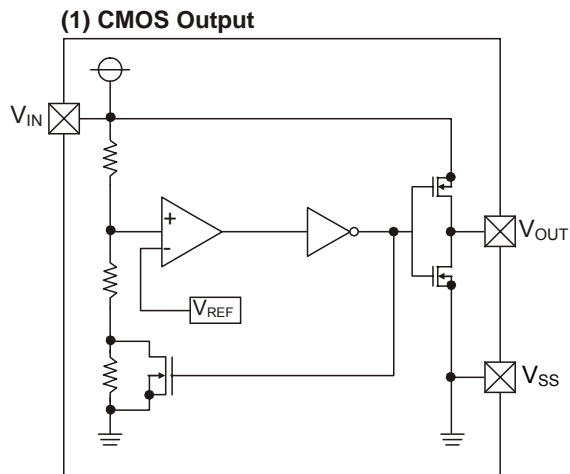
## Ordering Information – Green Products (continued)

Ordering Number	Output Configuration	Detect Voltage	Voltage Suffix	Package	Shipping
GM5510N-1.8ST23RG	N-CH Open Drain	1.8V	C	SOT-23	3,000 Units / Reel
GM5510N-2.0ST23RG	N-CH Open Drain	2.0V	E	SOT-23	3,000 Units / Reel
GM5510N-2.7ST23RG	N-CH Open Drain	2.7V	K	SOT-23	3,000 Units / Reel
GM5510N-2.9ST23RG	N-CH Open Drain	2.9V	M	SOT-23	3,000 Units / Reel
GM5510N-2.93ST23RG	N-CH Open Drain	2.93V	S	SOT-23	3,000 Units / Reel
GM5510N-3.0ST23RG	N-CH Open Drain	3.0V	N	SOT-23	3,000 Units / Reel
GM5510N-3.08ST23RG	N-CH Open Drain	3.08V	N	SOT-23	3,000 Units / Reel
GM5510N-3.3ST23RG	N-CH Open Drain	3.3V	Q	SOT-23	3,000 Units / Reel
GM5510N-3.6ST23RG	N-CH Open Drain	3.6V	T	SOT-23	3,000 Units / Reel
GM5510N-4.0ST23RG	N-CH Open Drain	4.0V	X	SOT-23	3,000 Units / Reel
GM5510N-4.1ST23RG	N-CH Open Drain	4.1V	Y	SOT-23	3,000 Units / Reel
GM5510N-4.2ST23RG	N-CH Open Drain	4.2V	Z	SOT-23	3,000 Units / Reel
GM5510N-1.8ST89RG	N-CH Open Drain	1.8V	18	SOT89	1,000 Units / Reel
GM5510N-2.0ST89RG	N-CH Open Drain	2.0V	20	SOT89	1,000 Units / Reel
GM5510N-2.7ST89RG	N-CH Open Drain	2.7V	27	SOT89	1,000 Units / Reel
GM5510N-2.9ST89RG	N-CH Open Drain	2.9V	29	SOT89	1,000 Units / Reel
GM5510N-3.0ST89RG	N-CH Open Drain	3.0V	30	SOT89	1,000 Units / Reel
GM5510N-3.08ST89RG	N-CH Open Drain	3.08V	30	SOT89	1,000 Units / Reel
GM5510N-3.3ST89RG	N-CH Open Drain	3.3V	33	SOT89	1,000 Units / Reel
GM5510N-3.6ST89RG	N-CH Open Drain	3.6V	36	SOT89	1,000 Units / Reel
GM5510N-4.0ST89RG	N-CH Open Drain	4.0V	40	SOT89	1,000 Units / Reel
GM5510N-4.1ST89RG	N-CH Open Drain	4.1V	41	SOT89	1,000 Units / Reel
GM5510N-4.2ST89RG	N-CH Open Drain	4.2V	42	SOT89	1,000 Units / Reel

## Absolute Maximum Ratings (Note 1)

Rating	Symbol	Value	Unit
Input Voltage	$V_{IN}$	12	V
Output Current	$I_{OUT}$	50	mA
Output Voltage	CMOS	$V_{SS} - 0.3$ to $V_{IN} + 0.3$	V
	N-CH Open Drain	$V_{SS} - 0.3$ to 12	
Power Dissipation	SOT-23	150	mW
	SOT-89	500	
Operating Ambient Temperature	$T_A$	- 40 to 125	/W
Storage Temperature Range	$T_{STG}$	- 65 to 150	
Lead Temperature (Soldering, 10 sec)		+ 260	

## Block Diagram



**Electrical Characteristics:**  $V_{DF}(T) = 1.6 \text{ to } 6.0\text{V} \pm 2\%$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	Circuit
Detect Voltage	$V_{DF}$		$V_{DF} \times 0.98$	$V_{DF}$	$V_{DF} \times 1.02$	V	1
Hysteresis Range	$V_{HYS}$		$V_{DF} \times 0.02$	$V_{DF} \times 0.05$	$V_{DF} \times 0.08$	V	1
Supply Current	$I_{SS}$	$V_{IN} = 1.5\text{V}$		0.7	2.3	$\mu\text{A}$	2
		$V_{IN} = 2.0\text{V}$		0.8	2.7		
		$V_{IN} = 3.0\text{V}$		0.9	3.0		
		$V_{IN} = 4.0\text{V}$		1.0	3.2		
		$V_{IN} = 5.0\text{V}$		1.1	3.6		
Operating Voltage	$V_{IN}$	$V_{DF}(T) = 1.6\text{V to } 6.0\text{V}$	0.7		10.0	V	1
Output Current	$I_{OUT}$	Nch $V_{DS} = 5\text{V}$	$V_{IN} = 1.0\text{V}$	1.0	2.2	mA	3
			$V_{IN} = 2.0\text{V}$	3.0	7.7		
			$V_{IN} = 3.0\text{V}$	5.0	10.1		
			$V_{IN} = 4.0\text{V}$	6.0	11.5		
			$V_{IN} = 5.0\text{V}$	7.0	13.0		
		Pch $V_{DS} = 2.1\text{V}$	$V_{IN} = 8.0\text{V}$	-10	-2.0		
Temperature Characteristics	$\frac{\Delta V_{DF}}{\Delta T_{OPR} \times V_{DF}}$	$-40^{\circ}\text{C} \leq T_{OPR} \leq 85^{\circ}\text{C}$		$\pm 100$		ppm/ $^{\circ}\text{C}$	5
Delay Time ( $V_{DR} \rightarrow V_{OUT}$ Inversion)	tDLY				0.2	Ms	5

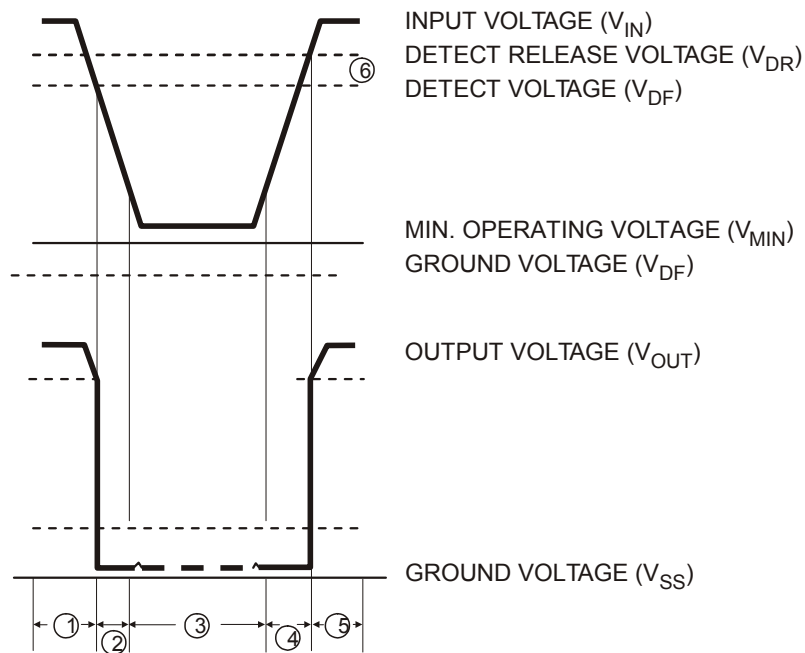
Note:  $V_{DF}(T)$ : Established Detect Voltage Value

Release Voltage:  $V_{DR} = V_{DF} + V_{HYS}$



## Function Description – CMOS Output Configuration

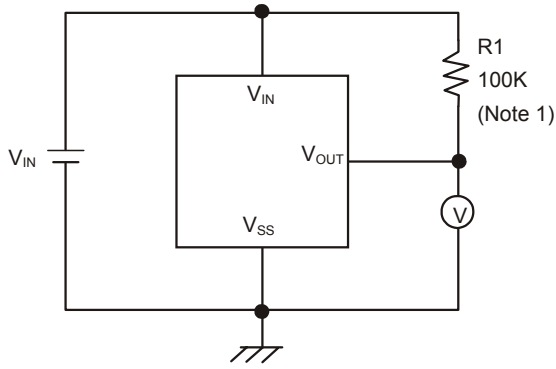
- ① When input voltage ( $V_{IN}$ ) rises above detect voltage ( $V_{DF}$ ), output voltage ( $V_{OUT}$ ) will be equal to  $V_{IN}$ . (A Condition of high impedance exists with N-ch open drain output Configurations)
- ② When input voltage ( $V_{IN}$ ) falls below detect voltage ( $V_{DF}$ ), output voltage ( $V_{OUT}$ ) will be equal to the ground voltage ( $V_{SS}$ ) level.
- ③ When input voltage ( $V_{IN}$ ) falls to a level below that of the minimum operating voltage ( $V_{MIN}$ ), output will become unstable. In this condition,  $V_{IN}$  will equal to the pulled-up output (Should output be pulled-up).
- ④ When input voltage ( $V_{IN}$ ) rises above the ground voltage ( $V_{SS}$ ) level, output will be unstable at levels below the minimum operating voltage ( $V_{MIN}$ ). Between the  $V_{MIN}$  and detect release voltage ( $V_{DR}$ ) levels, the ground voltage ( $V_{SS}$ ) level will be maintained.
- ⑤ When input voltage ( $V_{IN}$ ) rises above detect release voltage ( $V_{DR}$ ), output voltage ( $V_{OUT}$ ) will be equal to  $V_{IN}$ . (A Condition of high impedance exists with N-ch open drain output Configurations).
- ⑥ The difference between  $V_{DR}$  and  $V_{DF}$  represents the hysteresis range.



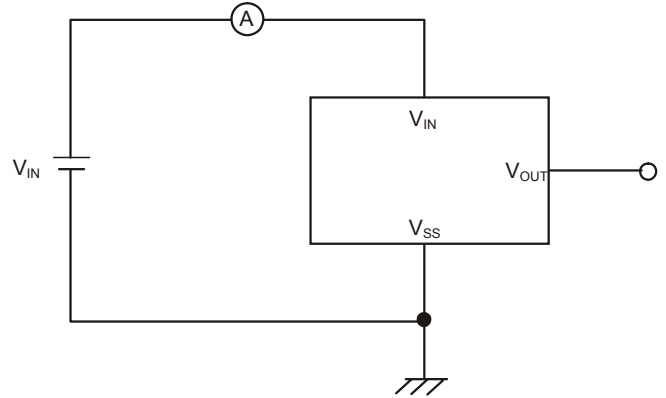
Timing Chart

## Test Circuits for Measurements

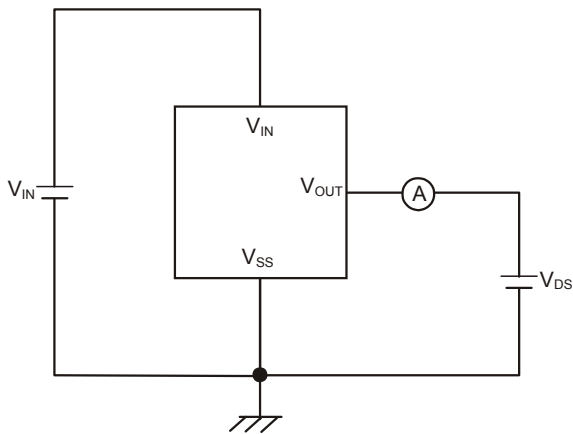
**Test Circuit 1**



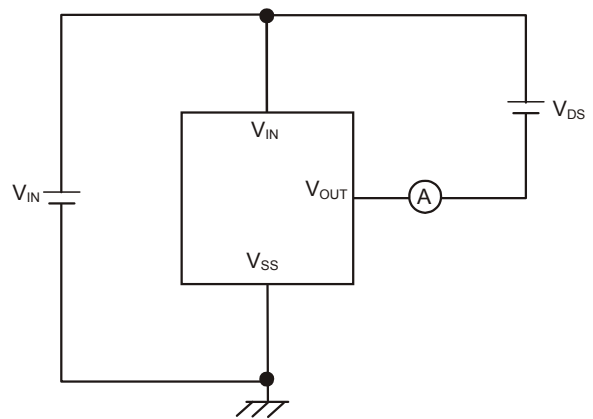
**Test Circuit 2**



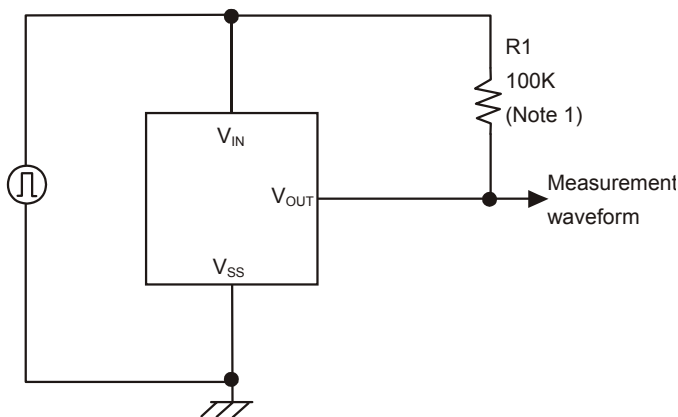
**Test Circuit 3**



**Test Circuit 4**

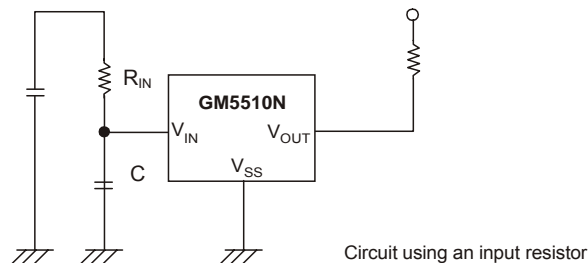


**Test Circuit 5**



### Application Notes

1. Please use this IC within the stated maximum ratings. Operation beyond these limits may cause degrading or permanent damage to the device.
2. When a resistor is connected between the  $V_{IN}$  pin and the input with CMOS output configurations, oscillation may occur as a result of voltage drops at  $R_{IN}$  if load Current ( $I_{OUT}$ ) exists. (Refer to the Oscillation Description (1) below)
3. When a resistor is connected between the  $V_{IN}$  pin and the input with CMOS output configurations, irrespective of N-ch output configurations, oscillation may occur as a result of through Current at the time of voltage release even if load Current ( $I_{OUT}$ ) does not exist. Refer to the Oscillation Description (2) below)
4. With a resistor is connected between the  $V_{IN}$  pin and the input, detect and release voltage will rise as a result of the IC's supply current flowing through the  $V_{IN}$  pin.
5. In order to stabilize the IC's operations, please ensure that  $V_{IN}$  pin's input frequency's rise and fall times are more than several  $\mu\text{Sec}/V$ .
6. Please use N-ch open drains configuration, when a resistor  $R_{IN}$  is connected between the  $V_{IN}$  pin and power source. In such case, please ensure that  $R_{IN}$  is less than  $10\text{k}\Omega$  and that  $C$  is more than  $0.1\mu\text{F}$



### Oscillation Description

#### (1) Output Current oscillation with the CMOS output Configuration

When the voltage applied at IN rises, release operations commence and the detector's output voltage increases. Load Current ( $I_{OUT}$ ) will flow at  $R_L$ . Because a voltage drop ( $R_{IN} \times I_{OUT}$ ) is produced at the  $R_{IN}$  resistor, located between the input (IN) and the  $V_{IN}$  pin, the load current will flow via the IC'S  $V_{IN}$  pin. The voltage drop will also lead to a fall in the voltage level at the  $V_{IN}$  pin. When the  $V_{IN}$  pin voltage level falls below the detect voltage level, detect operations will commence. Following detect operations, load Current flow will cease and since voltage drop at  $R_{IN}$  will disappear, the voltage level at the  $V_{IN}$  pin will rise and release operations will begin over again. Oscillation may occur with this "release – detect – release" repetition.

Further, this condition will also appear via means of a Similar mechanism during detect operations.

#### (2) Oscillation as a result of through Current

Since the GM5510 Series are CMOS IC'S, through current will flow when the IC'S internal circuit switching operates (during release and detect operations). Consequently, oscillation is liable to occur as a result of drops in voltage at the through Current's resistor ( $R_{IN}$ ) during release voltage operations. (Refer to Figure 3)

Since hysteresis exists during detect operations, oscillation is unlikely to occur.

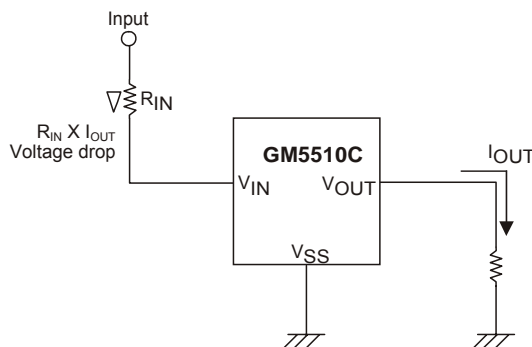


Figure 2 Oscillation in relation to output current

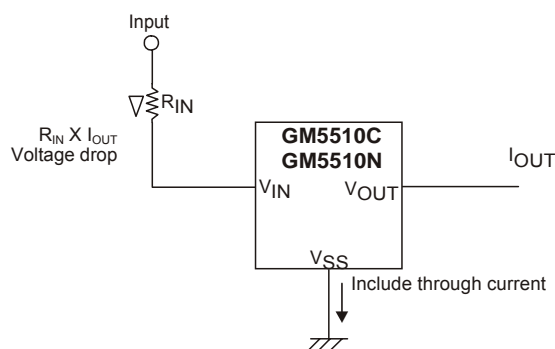
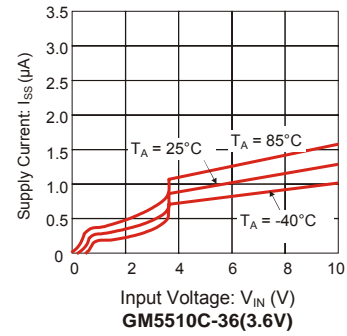
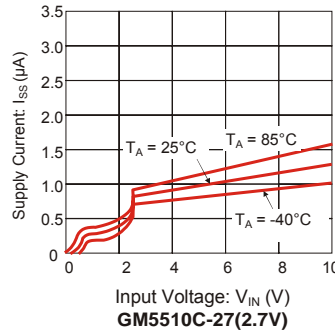
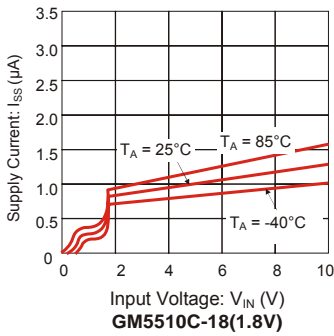


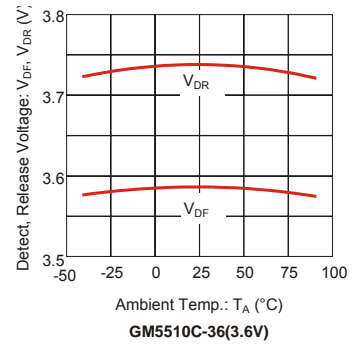
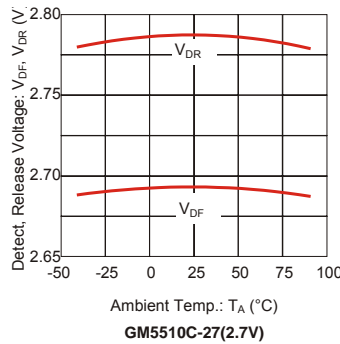
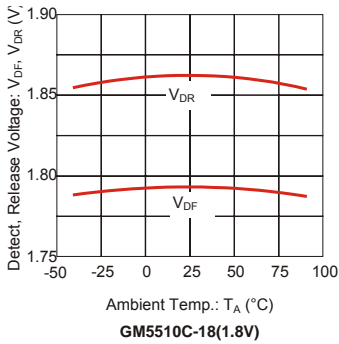
Figure 3 Oscillation in relation to through current

### TYPICAL PERFORMANCE CHARACTERISTICS

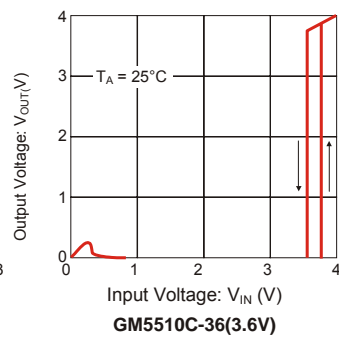
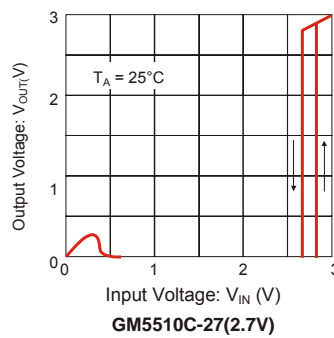
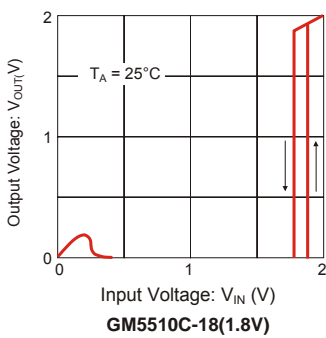
Supply Current vs. Input voltage



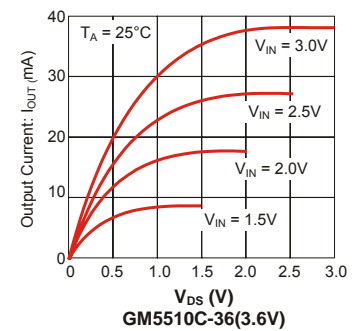
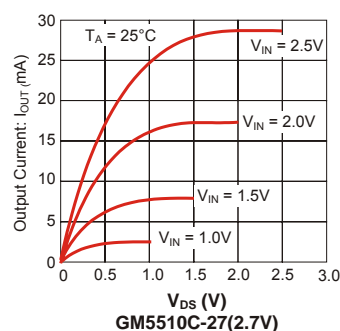
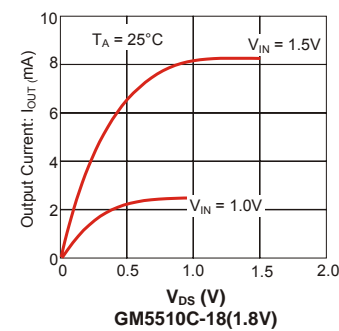
Detect, Release Voltage vs. Ambient Temperature



Output Voltage vs. Input Voltage

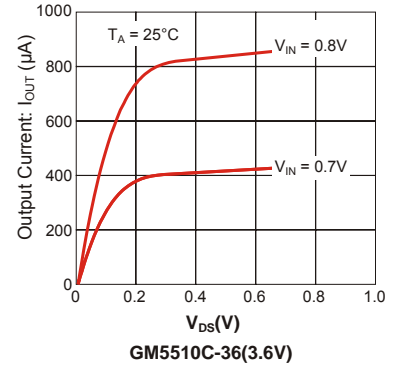
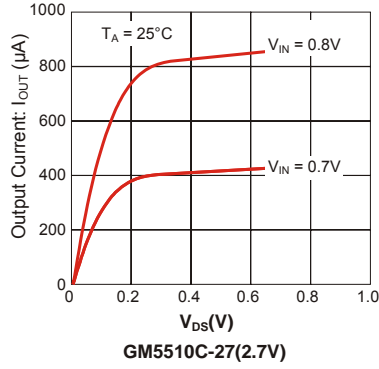
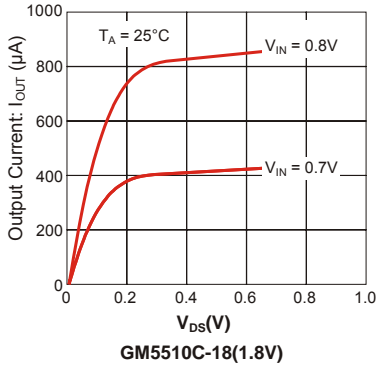


N-ch Driver Output current vs.  $V_{DS}$

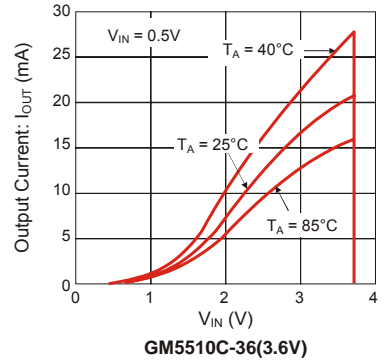
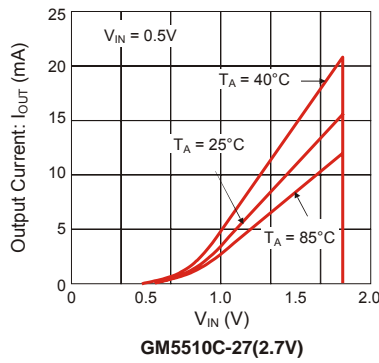
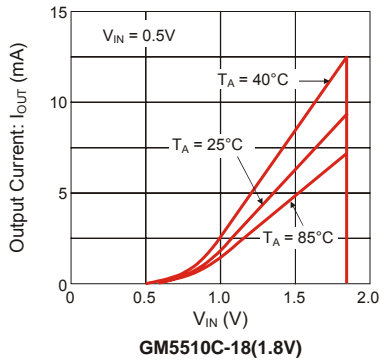


### TYPICAL PERFORMANCE CHARACTERISTICS

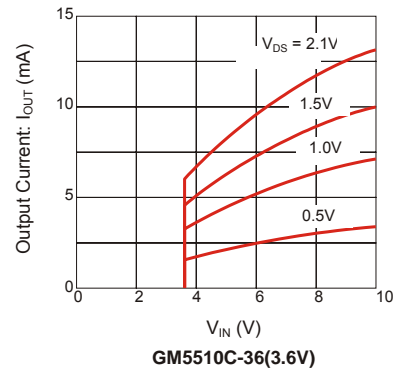
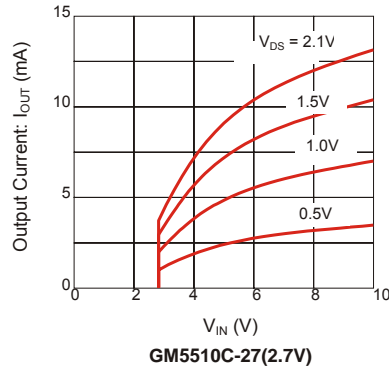
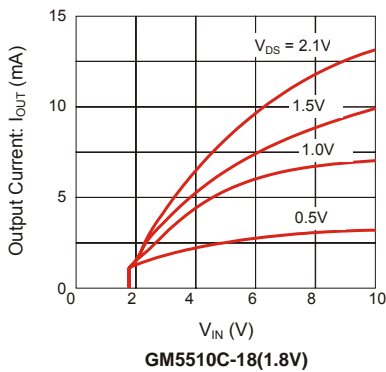
#### N-ch Driver Output current vs. $V_{DS}$



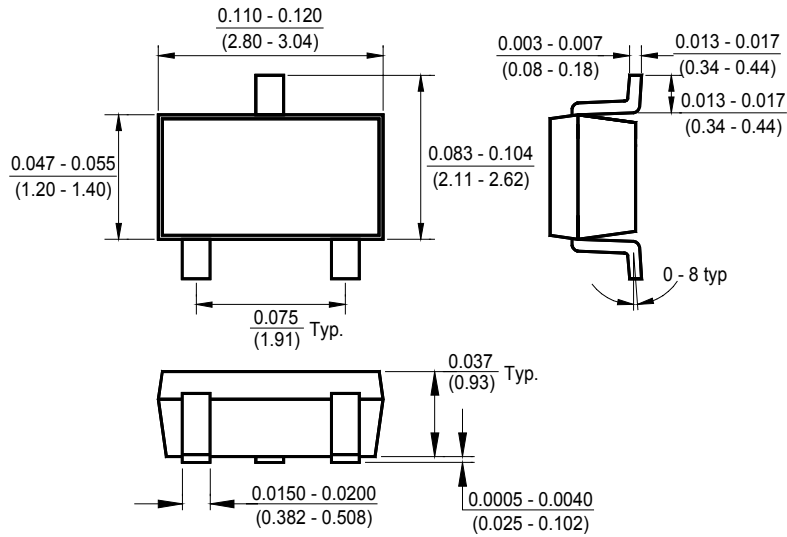
#### N-ch DRIVER OUTPUT CURRENT VS. INPUT VOLTAGE



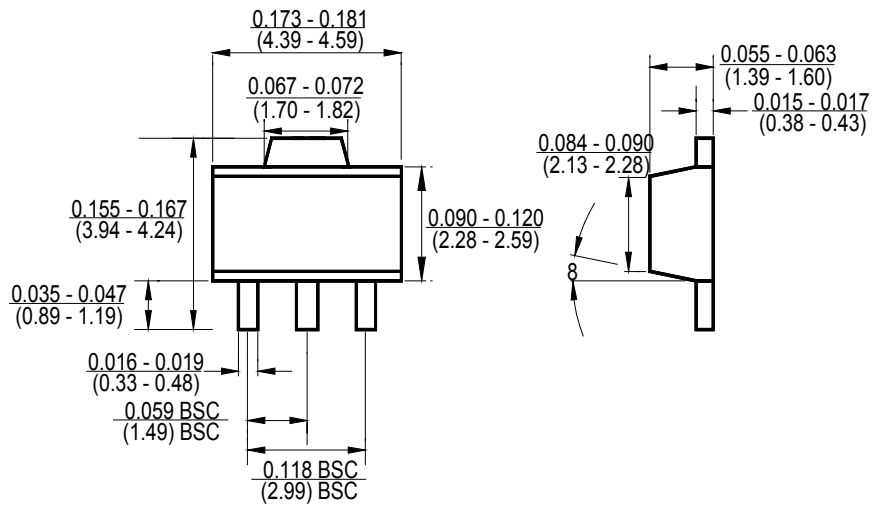
#### P-ch DRIVER OUTPUT CURRENT VS. INPUT VOLTAGE



## Package Outline Dimensions – SOT 23



## Package Outline Dimensions – SOT 89



## Ordering Number

**GM 5510 C                      ST23                      R                      G**

APM	Circuit Type	Output Configuration	Package Type	Shipping Type	
		C: CMOS N: N - CH Open Drain	ST25: SOT 25	R: Tape & Reel	Blank: Pb-free G:Green

Note:

**Pb-free products:**

- ◆ RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- ◆ Suitable for use in SnPb or Pb-free soldering processes with 100% matte tin (Sn) plating.

**Green products:**

- ◆ Lead-free (RoHS compliant)
- ◆ Halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight)