LDO REGULATOR WITH RESET

NO.EA-111-140530

OUTLINE

The R5511x Series are CMOS-based voltage regulator (LDO) ICs equipped with a voltage detector (VD). LDO function of the R5511x has features of high ripple rejection, low dropout voltage, high output voltage accuracy, and low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a current limit circuit, a voltage detector, and a chip enable circuit. The output of built-in voltage detector is Nch open drain type. (With the mask option CMOS output type is also available.)

The output voltage and the detector threshold voltage are fixed in the IC. Low supply current by the merit of CMOS process and the built-in transistor with low ON-resistance make low dropout voltage. These regulators in the R5511x Series are remarkable improvement on the current regulators in terms of ripple rejection, input transient response, and load transient response. Furthermore, the R5511x series can supervise input voltage (the input voltage means the input level for V_{DD} or V_{SENSE} pin) with built-in detector. Thus, the R5511x series are suitable not only for cellular handsets but also for power supply for CD-drives, DVD-drives, and so forth.

Since the packages for these ICs are the SON-6, SOT-23-5, SOT-89-5 package, high density mounting of the ICs on boards is possible.

FEATURES

- Supply Current ..... Typ. 50μA
- Standby Current ..... Typ. 1.5μA
- Ripple Rejection ..... Typ. 75dB (f=1kHz)
- Output Current ..... Min. 300mA
- Output Voltage Range ..... 1.2V to 4.0V
- Output Voltage Accuracy ..... ±1.5% (V_{OUT} ≥ 2.0V)
- Dropout Voltage ..... Typ. 0.1V (V_{OUT}=2.8V, I_{OUT}=100mA)
- Detector Threshold Range ..... 1.2V to 5.0V
- Detector threshold Accuracy ..... ±1.5% (V_{OUT} ≥ 2.0V)
- Low Temperature-drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Absolute Maximum Voltage 6.5V
- Packages SON-6, SOT-23-5, SOT-89-5
- Output Delay Time (t_{delay}) ..... A: (t_{delay}=1ms, Hysteresis5%)
  B: (t_{delay}=20ms, Hysteresis5%)
  C: (t_{delay}=60ms, Hysteresis5%)
  D: (t_{delay}=240ms, no Hysteresis)

∗Output Delay Time : 120ms / With or without hysteresis can be designated with user's request

- Ceramic capacitors are recommended to be used with this IC .....1μF or more
- Built-in Fold-back Protection Circuit

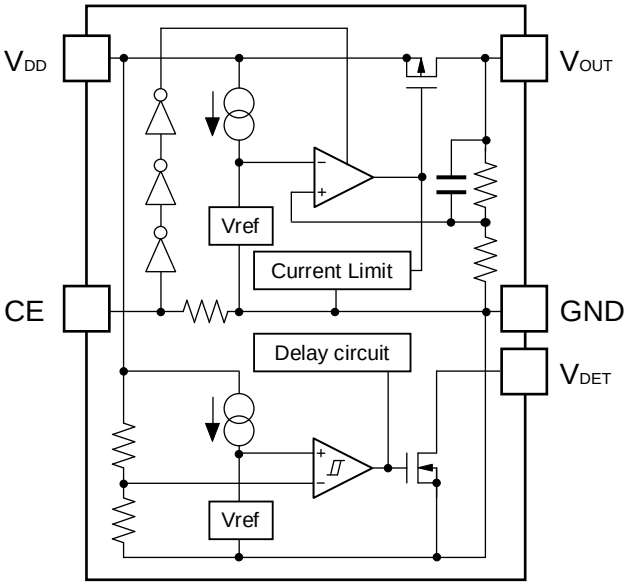
APPLICATIONS

- CD-drives and DVD-drives
- Power source for Cellular Phone

BLOCK DIAGRAMS

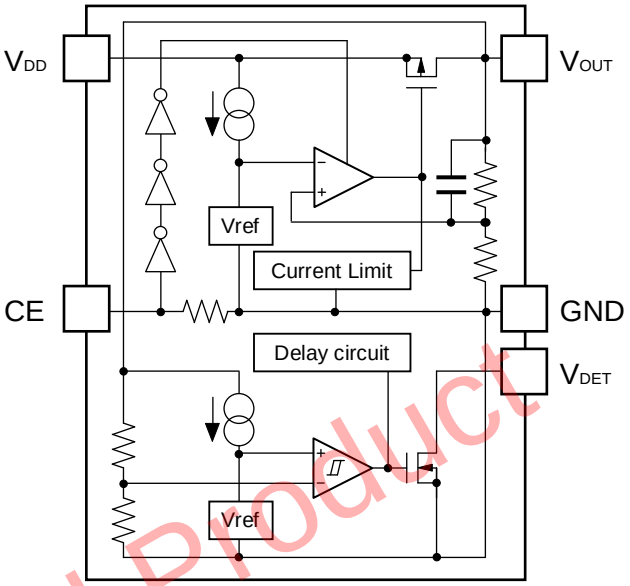
R5511xxxxxA

(V_{IN} detect Nch Open drain)



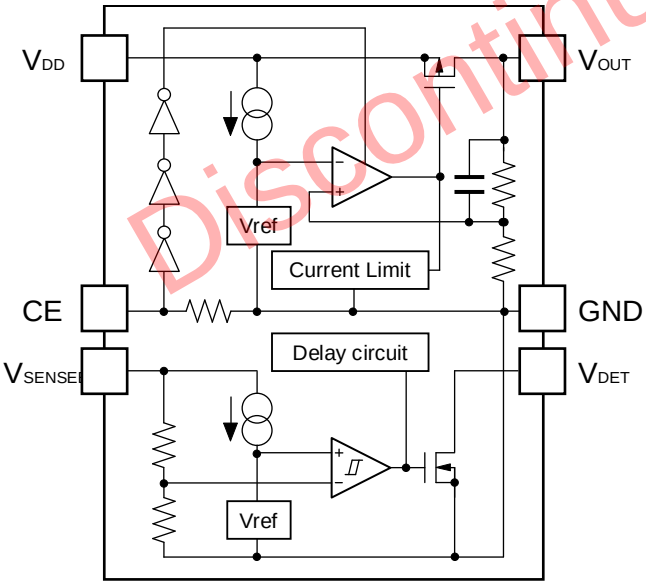
R5511xxxxxB

(V_{OUT} detect Nch Open drain)



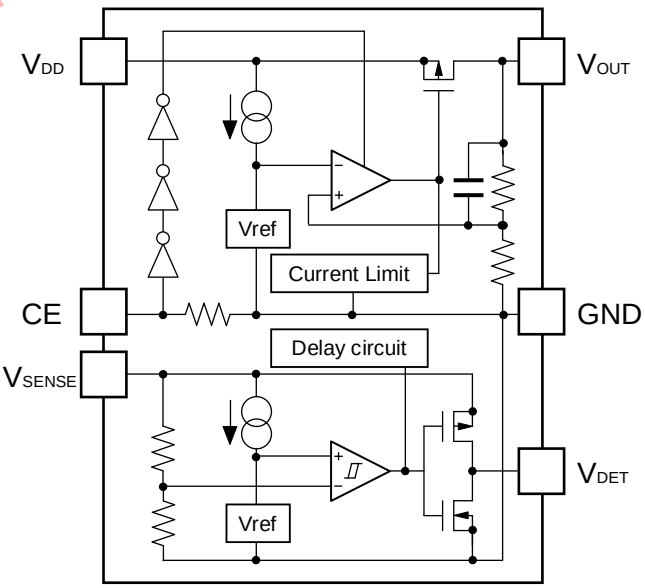
R5511DxxxxC

(V_{SENSE} detect Nch Open drain)



R5511DxxxxD

(V_{SENSE} detect CMOS Output)



SELECTION GUIDE

The output voltage setting code number, hysteresis, output delay time, the detecting target, output type can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5511Dxxx$∗–TR-FE	SON-6	3,000pcs	○	○
R5511Nxxx$#-TR-FE	SOT-23-5	3,000pcs	○	○
R5511Hxxx$#-T1-FE	SOT-89-5	1,000pcs	○	○

xxx : Serial number code of output voltage and detector threshold setting, with/without hysteresis

$: Designation of output delay time
- (A) 1ms
- (B) 20ms
- (C) 60ms
- (D) 240ms

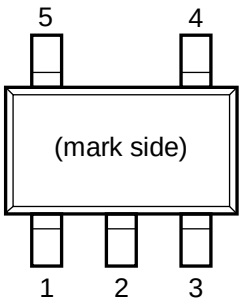
∗ : Designation of the detecting target and output type
- (C) V_{SENSE} detect Nch Open drain
- (D) V_{SENSE} detect CMOS Output

#: Designation of the detecting target and output type
- (A) V_{IN} detect Nch Open drain
- (B) V_{OUT} detect Nch Open drain

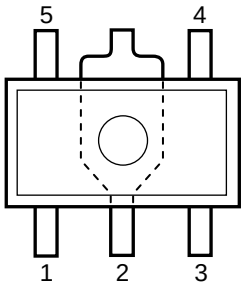
∗With Hysteresis / No delay time version can be designated.

PIN CONFIGURATION

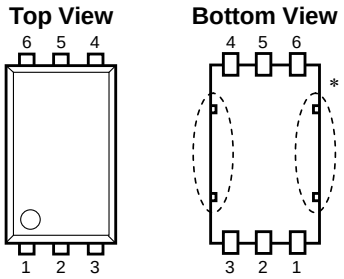
● SOT-23-5



● SOT-89-5



● SON-6



PIN DESCRIPTIONS

● SON-6

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin
2	GND	Ground Pin
3	V_{OUT}	Voltage Regulator Output Pin
4	V_{DD}	Input and SENSE Pin of Voltage Detector
5	V_{SENSE}	SENSE Pin
6	V_{DET}	Voltage Detector Output Pin (Detect"L", Reset"H")

*) Tab suspension leads are GND level. (They are connected to the reverse side of this IC.)
The tab suspension leads should be open and do not connect to other wires or land patterns.

● SOT-23-5

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin
2	GND	Ground Pin
3	V_{DET}	Voltage Regulator Output Pin (Detect"L", Reset"H")
4	V_{DD}	Input and SENSE Pin of Voltage Detector
5	V_{OUT}	Voltage Detector Output Pin

● SOT-89-5

Pin No	Symbol	Pin Description
1	V_{DET}	Voltage Detector Output Pin (Detect"L", Reset"H")
2	GND	Ground Pin
3	CE	Chip Enable Pin
4	V_{OUT}	Voltage Regulator Output Pin
5	V_{DD}	Input and SENSE Pin of Voltage Detector

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Input Pin)	6.5	V
V_{SENSE}	Input Voltage (SENSE Pin)	6.5	V
V_{DET}	VD Output Voltage (CMOS Output)	−0.3 to V_{IN} + 0.3	V
	VD Output Voltage (Nch Open Drain)	−0.3 to 6.5	
V_{OUT}	Output Voltage	−0.3 to V_{IN} + 0.3	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation (SON-6) *	500	mW
	Power Dissipation (SOT-23-5) *	420	
	Power Dissipation (SOT-89-5) *	900	
Topt	Operating Temperature	−40 to +85	°C
Tstg	Storage Temperature	−55 to +125	°C

∗) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.
The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

- **R5511x**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage				6.0	V
I_{SS1}	Quiescent Current 1	V_{IN}–V_{OUT}=1.0V		50	80	μA
I_{SS2}	Quiescent Current 2	V_{IN}=-V_{DET}–0.1V, V_{CE}=0V		1.5	3.0	μA
I_{SS3}	Quiescent Current 3	V_{IN}=-V_{DET}+1.0V, V_{CE}=0V		1.5	3.0	μA

- **VR Part**

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output voltage	V_{IN}–V_{OUT}=1.0V I_{OUT}=30mA	2.0V ≤ V_{SET}	×0.985		×1.015	V
			1.5V < V_{SET} < 2.0V	–30		+30	mV
			1.2V ≤ V_{SET} ≤ 1.5V	×0.980		×1.020	V
I_{OUT}	Output Current	V_{IN}–V_{OUT}=1.0V		300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	V_{IN}–V_{OUT}=1.0V 1mA ≤ I_{OUT} ≤ 100mA*1			5	15	mV
V_{DIF}	Dropout Voltage	Refer to the Electrical Characteristics by Output Voltage					V
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	I_{OUT}=30mA V_{OUT}+0.5V ≤ V_{IN} ≤ 6.0V			0.05	0.15	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp–p V_{IN}–V_{REG1}=1.0V			75		dB
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=30mA –40°C ≤ Topt ≤ 85°C			±100		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V			50		mA
R_{PD}	Pull-down resistance for CE pin			2	5	14	MΩ
V_{CEH}	CE Input Voltage “H”			1.1		V_{IN}	V
V_{CEL}	CE Input Voltage “L”			0.0		0.3	V

∗1) Guaranteed by Design.

• VD Part

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	$2.0V \leq V_{SET}$	×0.985		×1.015	V
		$1.5V < V_{SET} < 2.0V$	−30		+30	mV
		$1.2V \leq V_{SET} \leq 1.5V$	×0.980		×1.020	V
V_{HYS}	Detector Threshold Hysteresis	Output Delay Time: 0ms, 20ms, 60ms	$-V_{DET}$ ×0.03	$-V_{DET}$ ×0.05	$-V_{DET}$ ×0.07	V
I_{OL}	Output Current	Refer to Electrical Characteristics by Detector Threshold				mA
I_{OH}						
V_{DDL}	Minimum Operating Voltage	I_{OUT}=10μA		0.65	0.80	V
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≤ Topt ≤ 85°C		±100		ppm /°C
tdelay	Output Delay Time	A Version	0.5	1.0	2.8	ms
		B Version	16	20	24	
		C Version	50	60	70	
		D Version	200	240	280	

• Electrical Characteristics by Output Voltage

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
$1.2V \leq V_{SET} < 1.5V$	I_{OUT}=100mA	0.18	0.28
$1.5V \leq V_{SET} < 1.8V$		0.16	0.22
$1.8V \leq V_{SET} < 2.2V$		0.14	0.20
$2.2V \leq V_{SET} < 2.8V$		0.12	0.17
$2.8V \leq V_{SET} \leq 4.0V$		0.10	0.15

• Electrical Characteristics by Detector Threshold

- Nch Open Drain Type

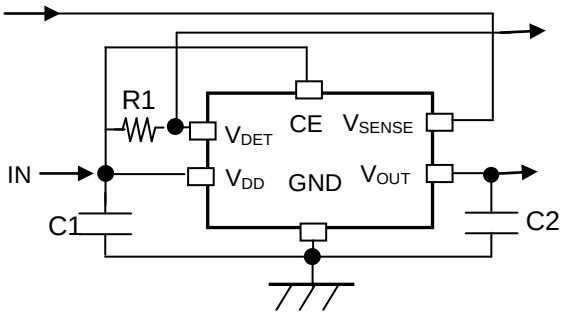
Detector Threshold $-V_{DET}$ (V)	"L" Output Current I_{OL} (mA)				
	Condition		Min.	Typ.	Max.
$1.2V \leq V_{DSET} < 1.6V$	V_{DD}=1.1V	V_{DS}=0.5V	1.1	2.8	5.0
$1.6V \leq V_{DSET} < 3.1V$	V_{DD}=1.5V		3.0	6.0	10.0
$3.1V \leq V_{DSET} \leq 5.0V$	V_{DD}=3.0V		8.0	11.0	15.0

- CMOS Output Type

Detector Threshold $-V_{DET}$ (V)	"H" Output Current I_{OH} (mA)			
	Condition	Min.	Typ.	Max.
$1.2V \leq V_{DSET} < 1.6V$, VS=1.7V	V_{DD}=VS V_{DS}=VS×0.8	0.10	0.20	0.35
$1.6V \leq V_{DSET} < 3.1V$, VS=3.3V		0.55	0.90	1.40
$3.1V \leq V_{DSET} \leq 5.0V$, VS=5.4V		1.50	2.10	2.90

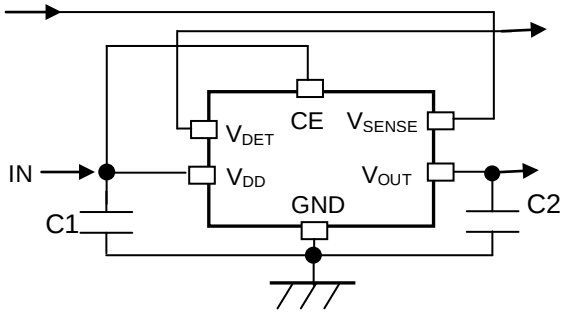
TYPICAL APPLICATION

R5511DxxxxC (Nch)



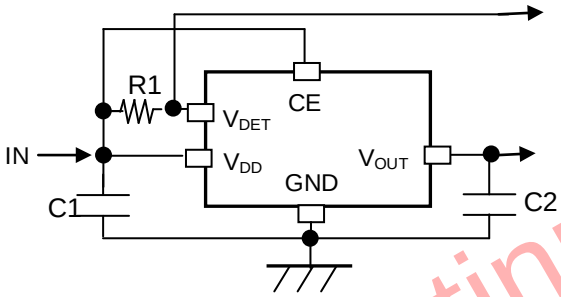
R1=470kΩ,C1=C2=Ceramic 1μF

R5511DxxxxD (CMOS)



C1=C2=Ceramic 1μF

R5511N/H Series



R1=470kΩ,C1=C2=Ceramic 1μF

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

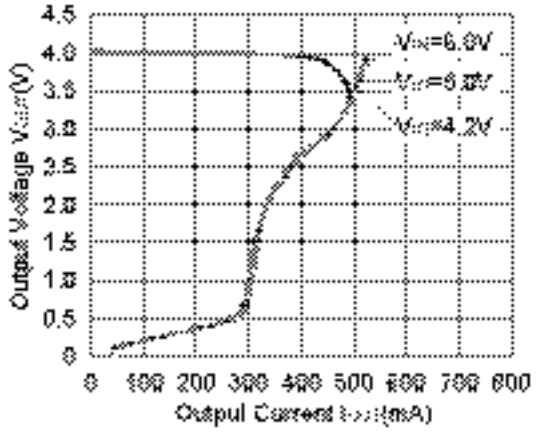
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1μF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

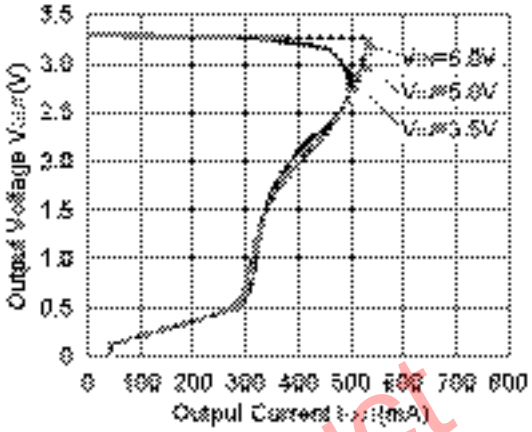
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (T_{opt}=25°C)

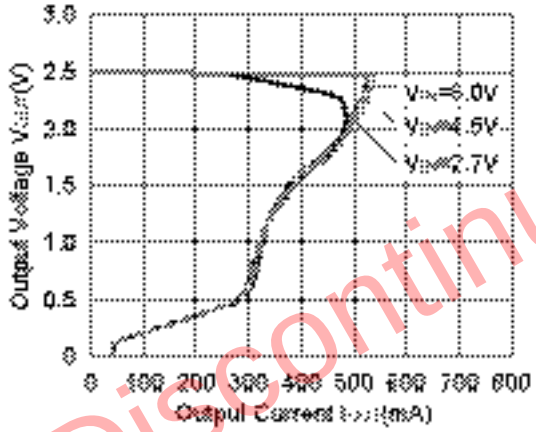
R5511x (VR=4.0V)



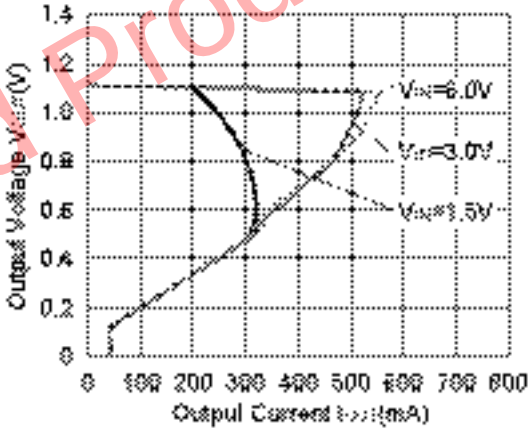
R5511x (VR=3.3V)



R5511x (VR=2.5V)

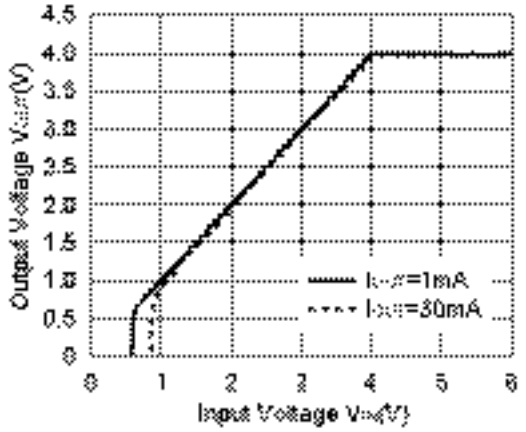


R5511x (VR=1.2V)

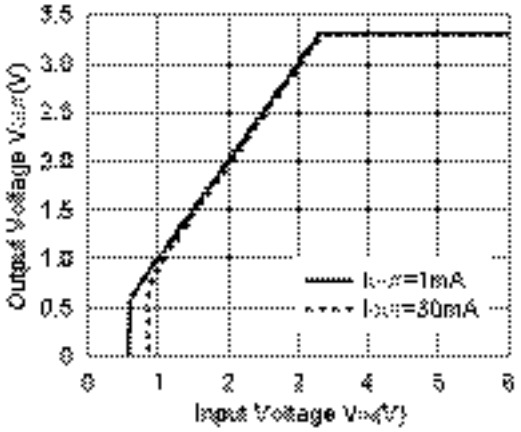


2) Input Voltage vs. Output Voltage (T_{opt}=25°C)

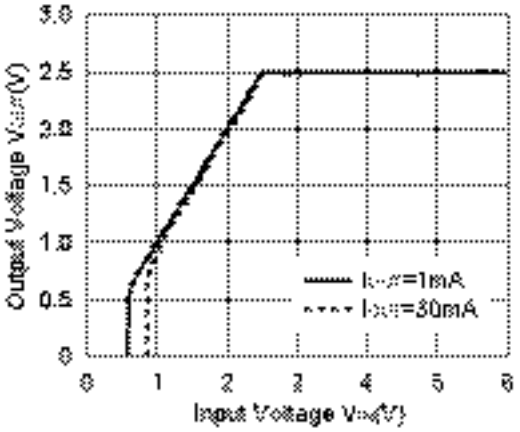
R5511x (VR=4.0V)



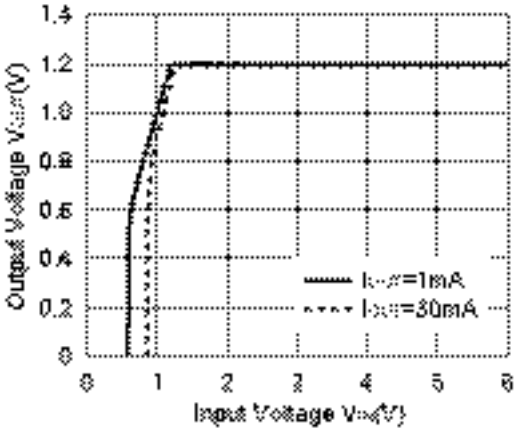
R5511x (VR=3.3V)



R5511x (VR=2.5V)

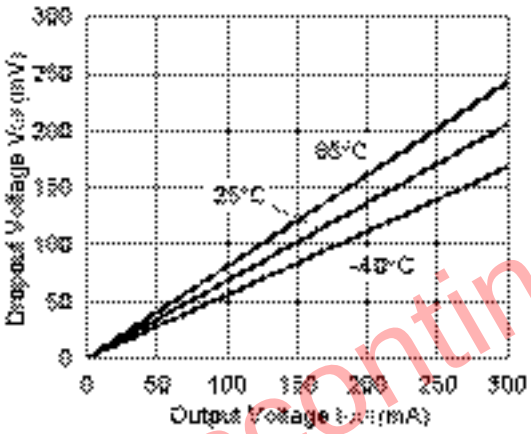


R5511x (VR=1.2V)

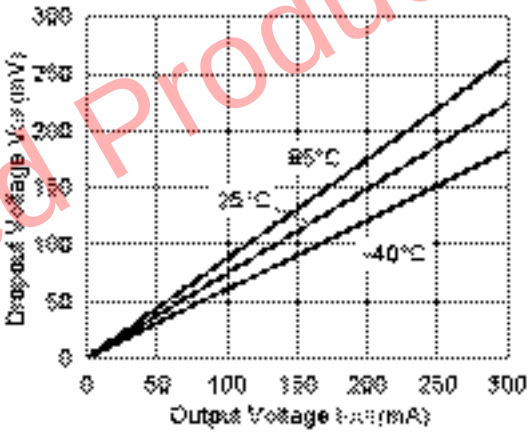


3) Dropout Voltage vs. Output Current

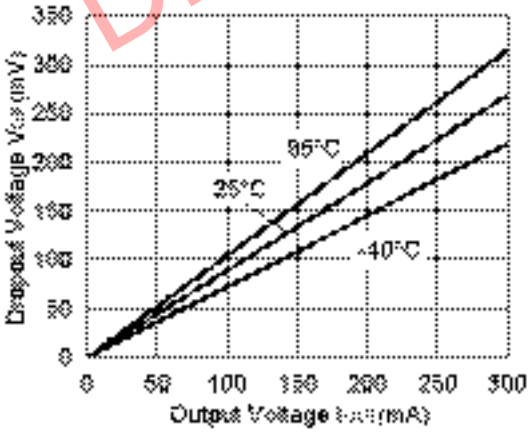
R5511x (VR=4.0V)



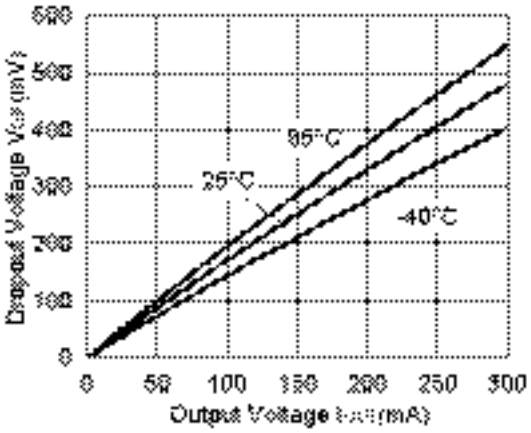
R5511x (VR=3.3V)



R5511x (VR=2.5V)

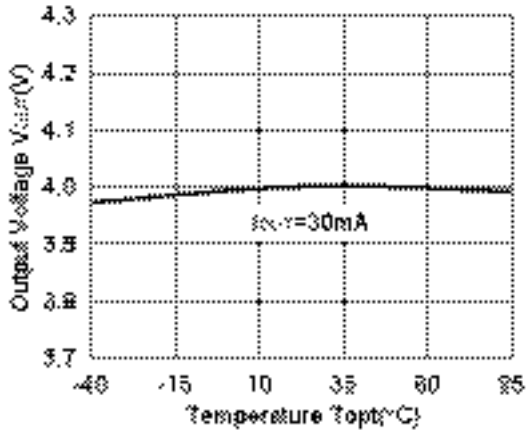


R5511x (VR=1.2V)

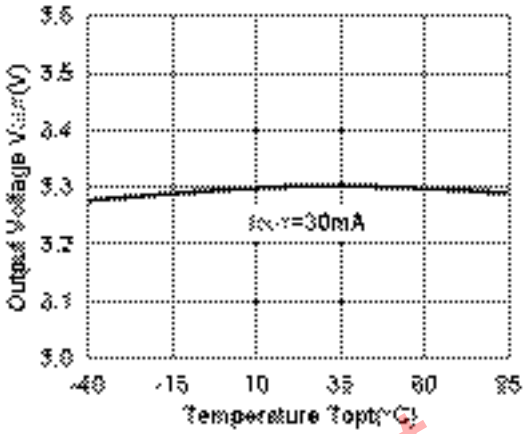


4) Output Voltage vs. Temperature

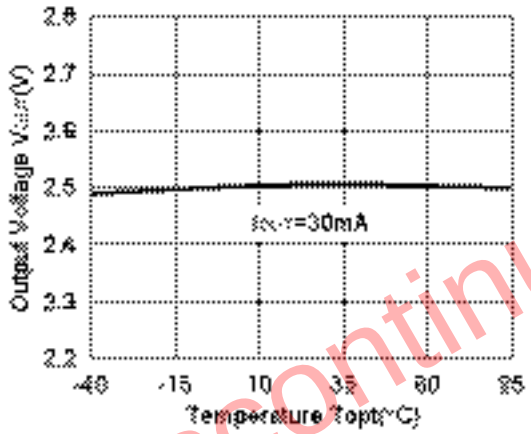
R5511x (VR=4.0V)



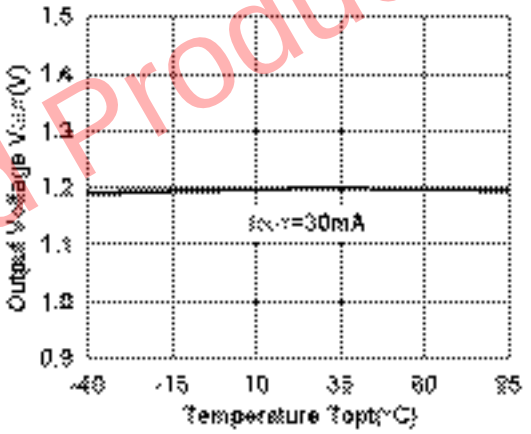
R5511x (VR=3.3V)



R5511x (VR=2.5V)

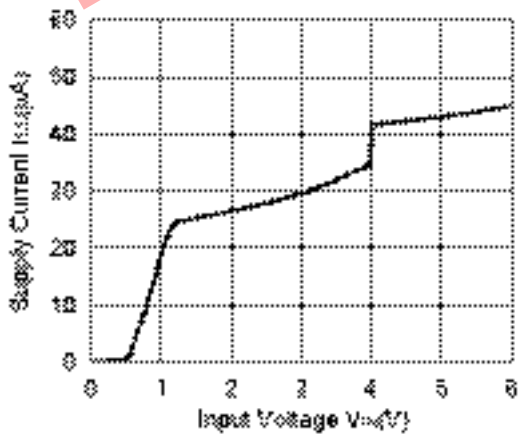


R5511x (VR=1.2V)

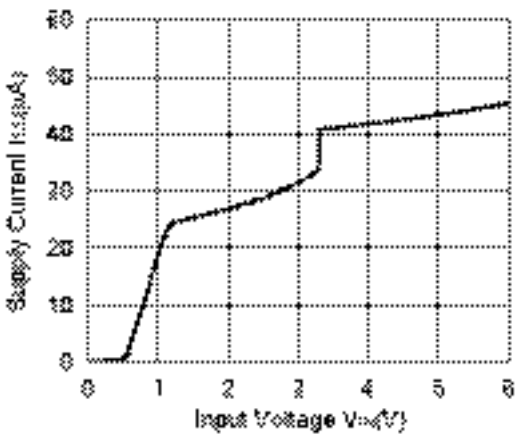


5) Supply Current vs. Input Voltage (Topt=25°C)

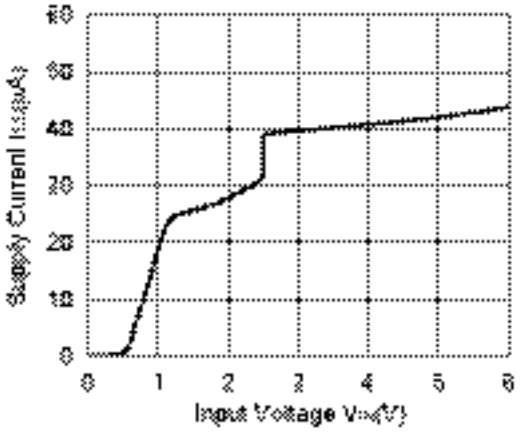
R5511x (VR=4.0V)



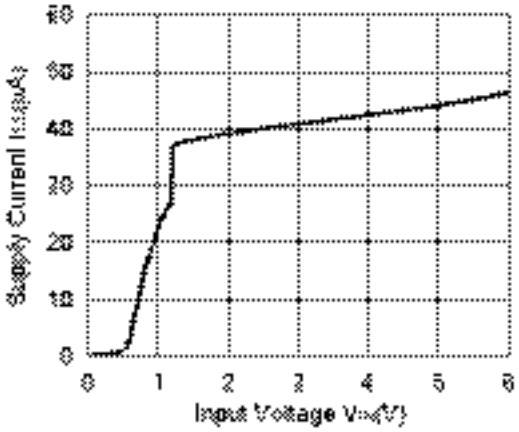
R5511x (VR=3.3V)



R5511x (VR=2.5V)

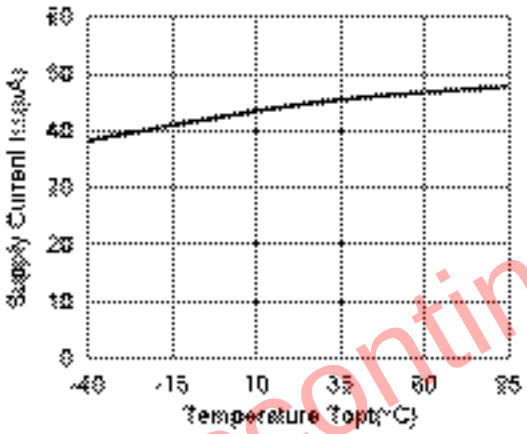


R5511x (VR=1.2V)

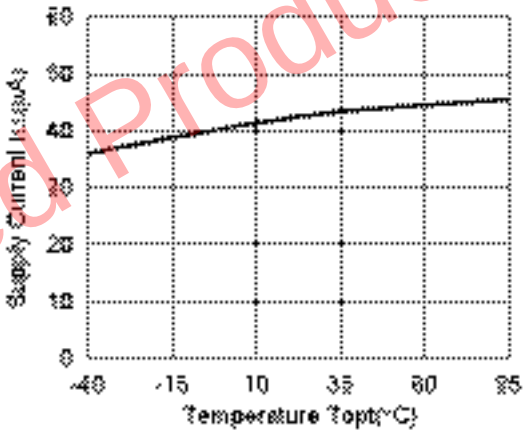


6) Supply Current vs. Temperature

R5511x (VR=4.0V)

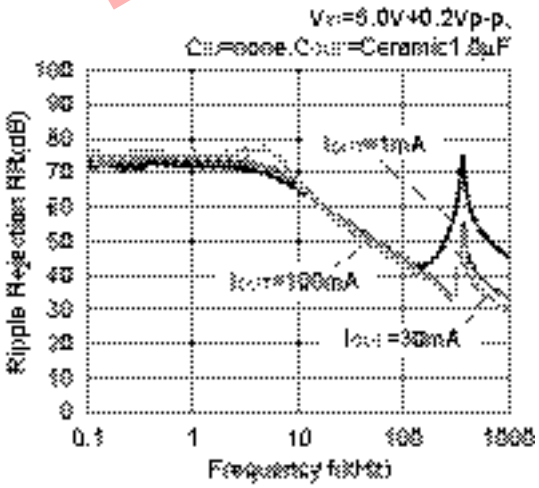


R5511x (VR=1.2V)

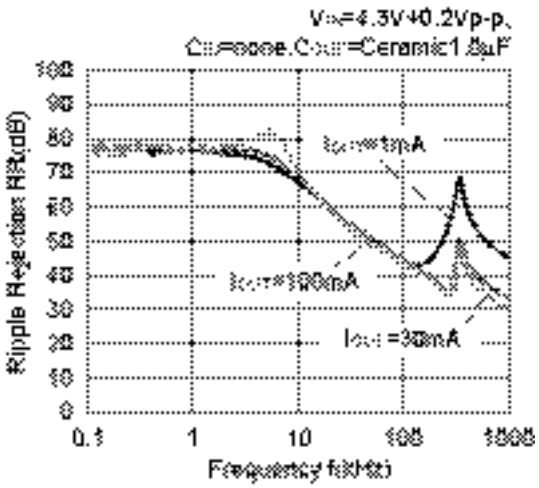


7) Ripple Rejection vs. Temperature (T_{opt}=25°C)

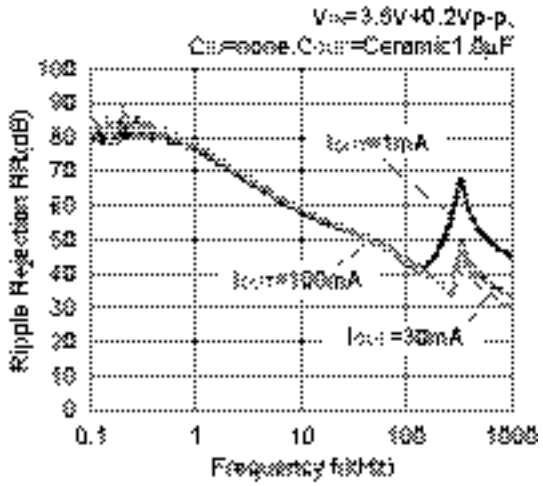
R5511x (VR=4.0V)



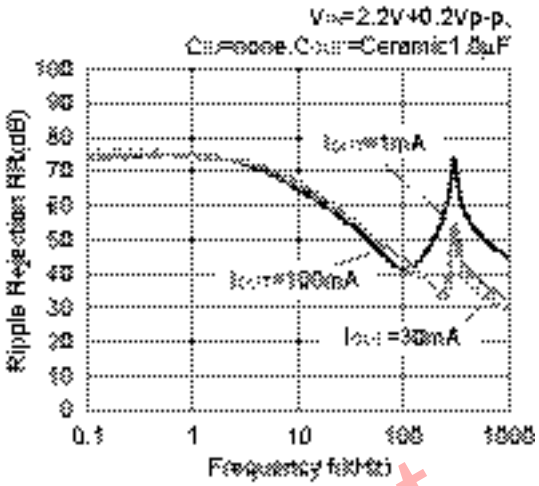
R5511x (VR=3.3V)



R5511x (VR=2.5V)

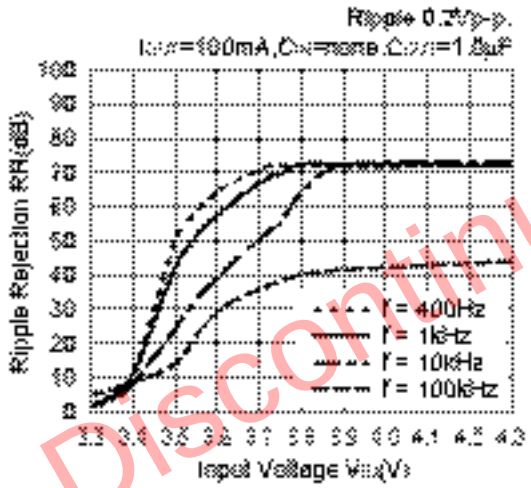


R5511x (VR=1.2V)

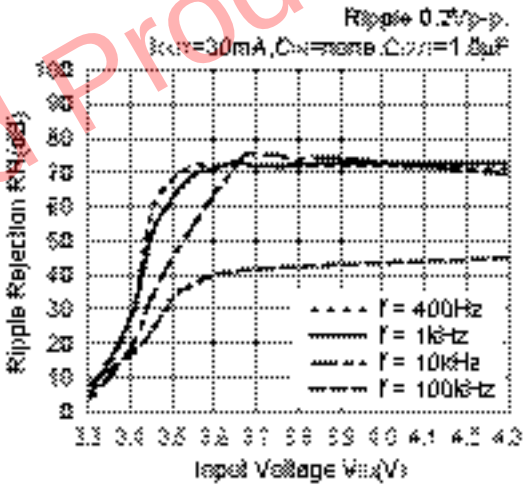


8) Ripple Rejection vs. Input Bias Voltage

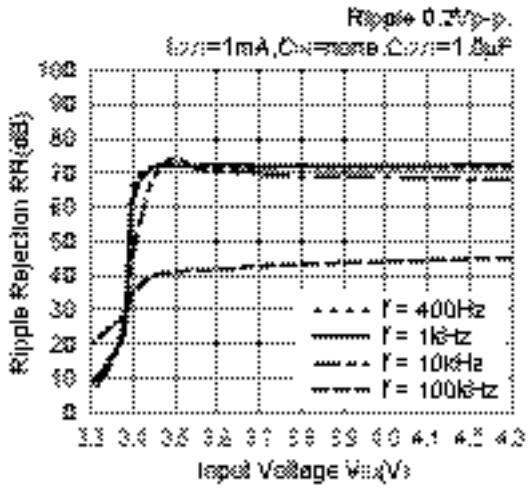
R5511x (VR=3.3V)



R5511x (VR=2.5V)

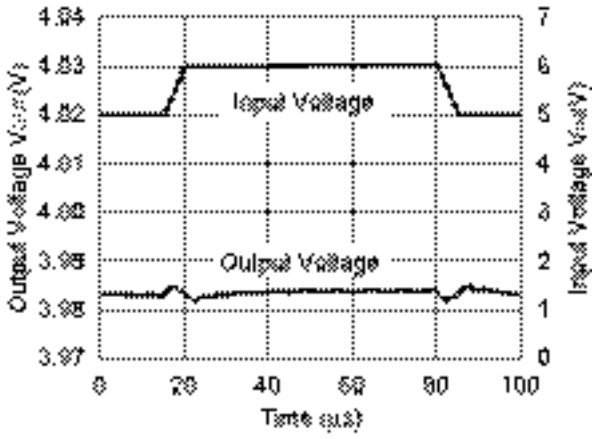


R5511x (VR=3.3V)

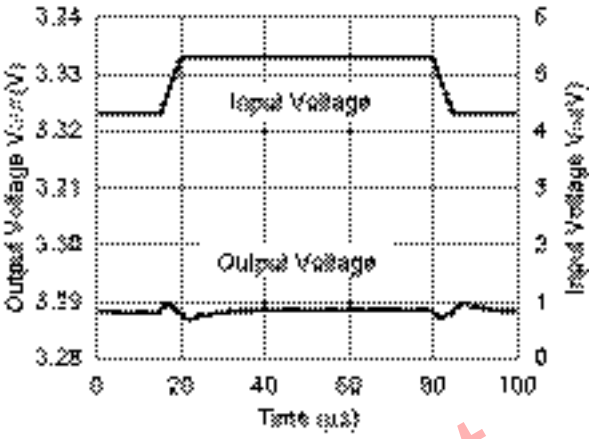


9) Input Transient Response

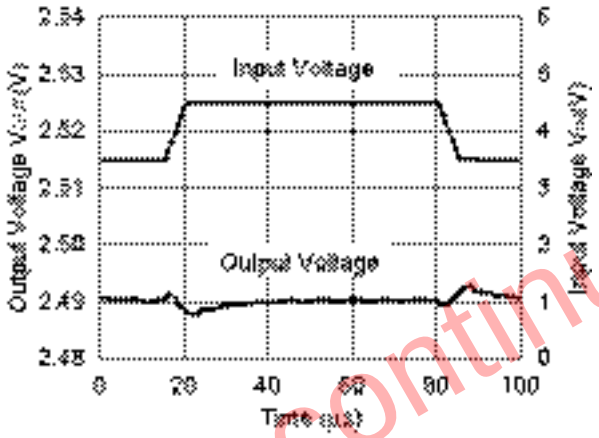
R5511x (VR=4.0V)



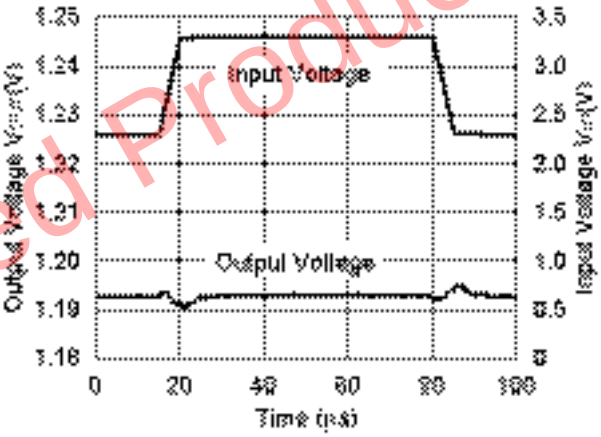
R5511x (VR=3.3V)



R5511x (VR=2.5V)

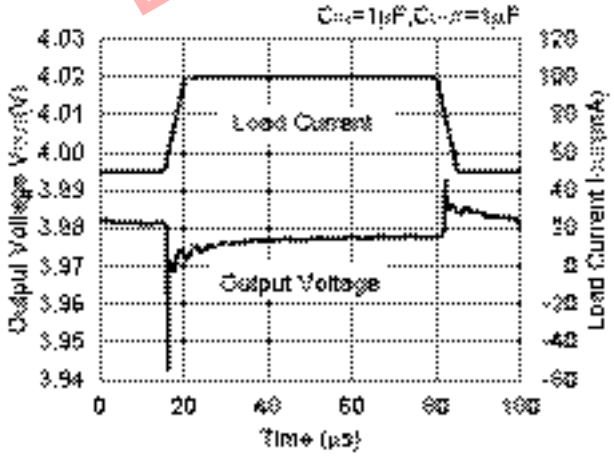


R5511x (VR=1.2V)

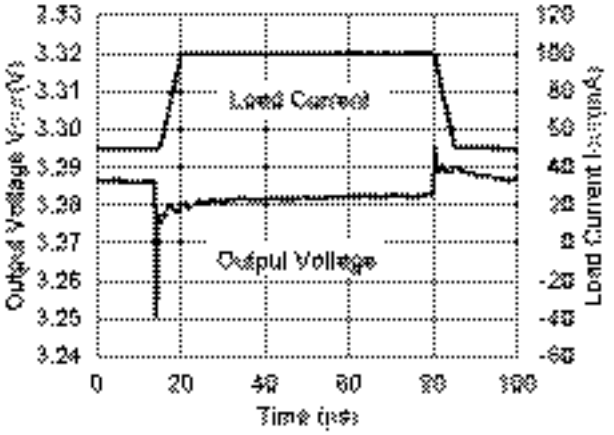


10) Load Transient Response

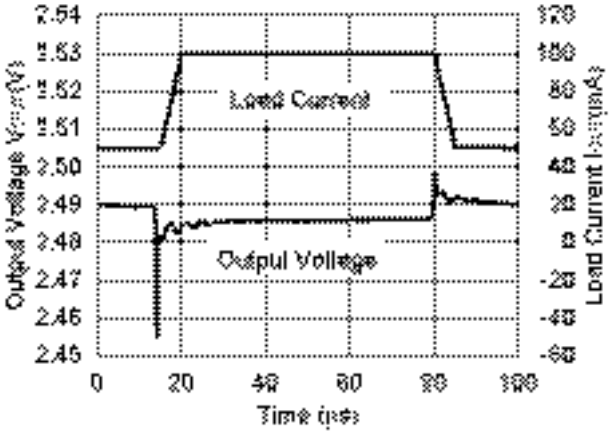
R5511x (VR=4.0V)



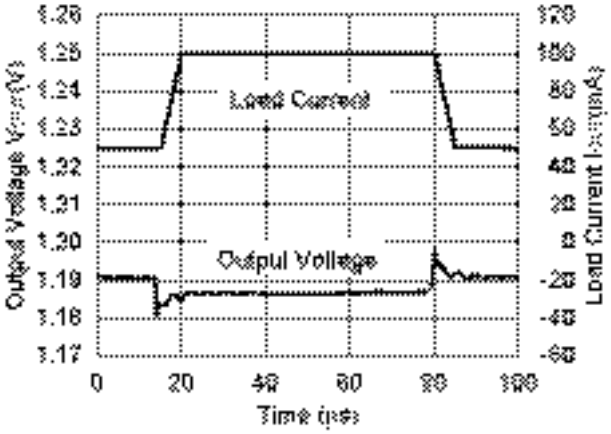
R5511x (VR=3.3V)



R5511x (VR=2.5V)

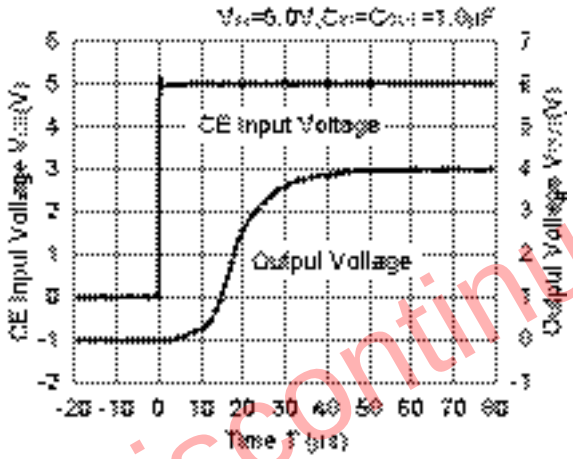


R5511x (VR=1.2V)

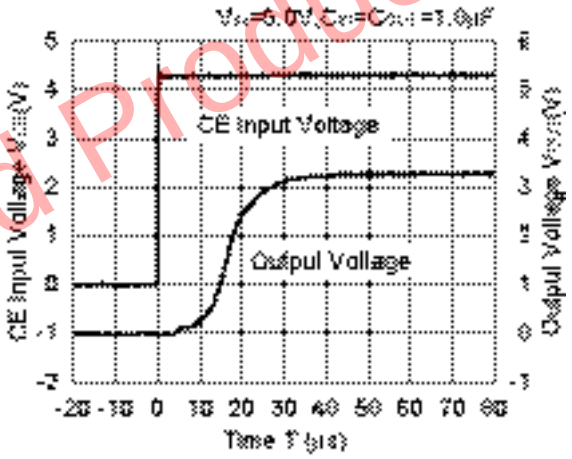


11) Turn-on Speed with CE

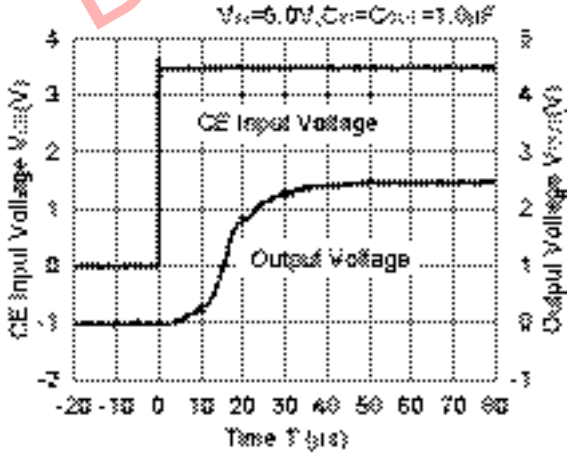
R5511x (VR=4.0V)



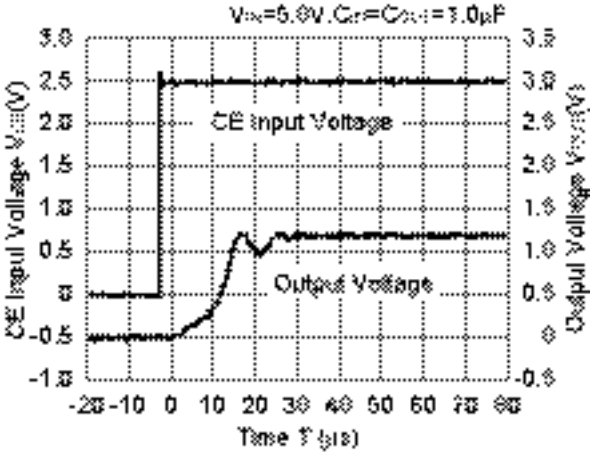
R5511x (VR=3.3V)



R5511x (VR=2.5V)

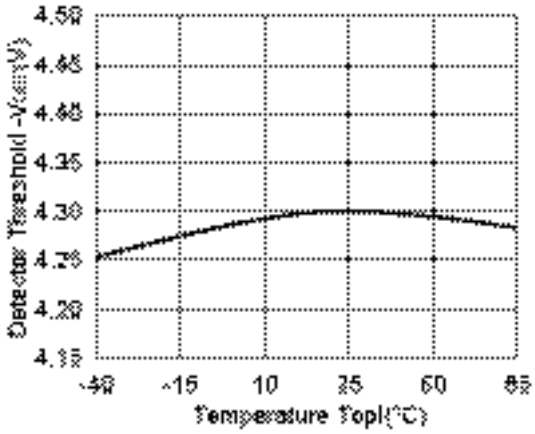


R5511x (VR=1.2V)

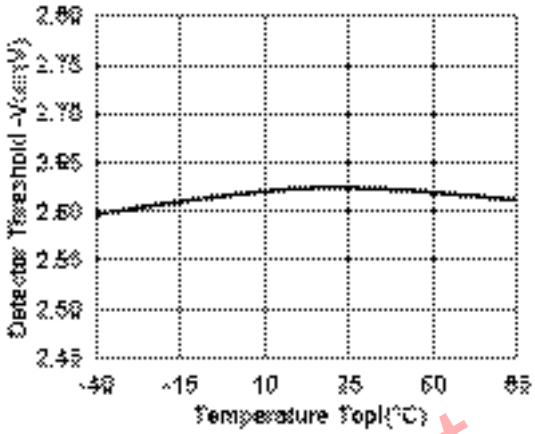


12) Detector Threshold vs. Temperature

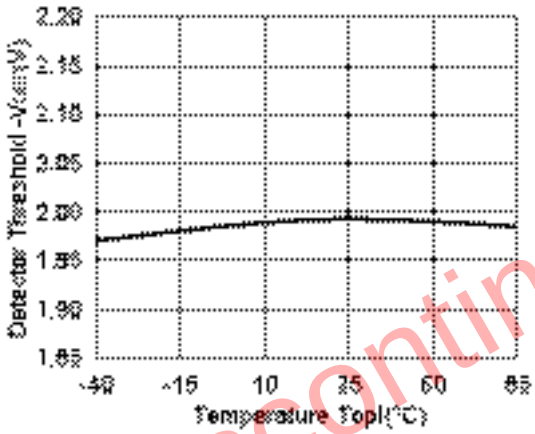
R5511x (–V_{DET}=4.3V)



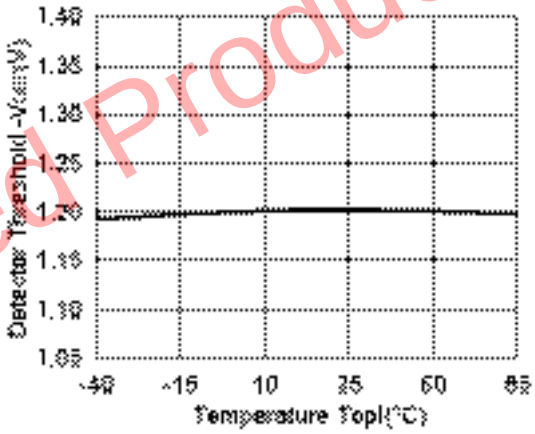
R5511x (–V_{DET}=2.63V)



R5511x (–V_{DET}=2.0V)

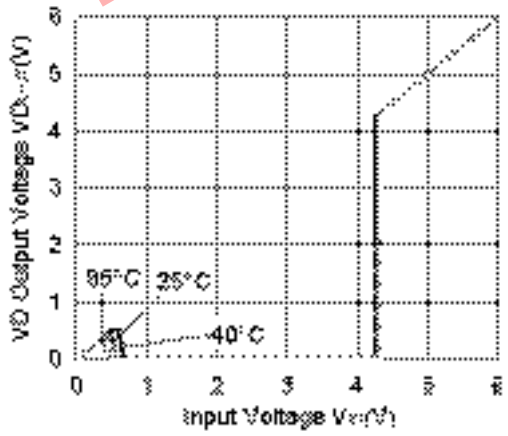


R5511x (–V_{DET}=1.2V)

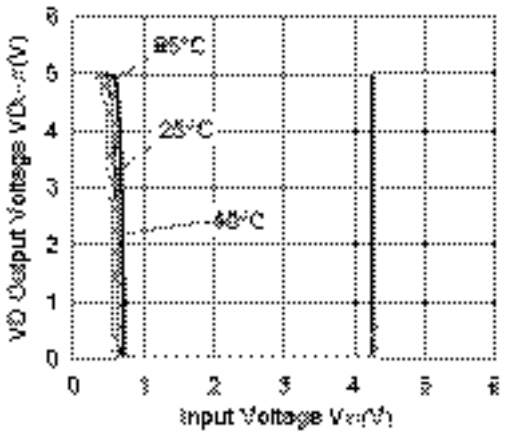


13) Detector Output Voltage vs. Input Voltage

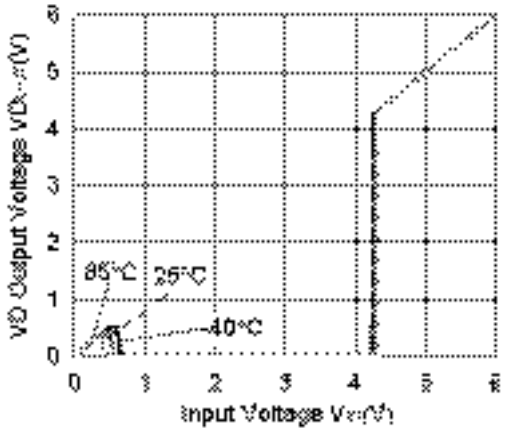
R5511x (–V_{DET}=4.3V V_{DD} pull-up)



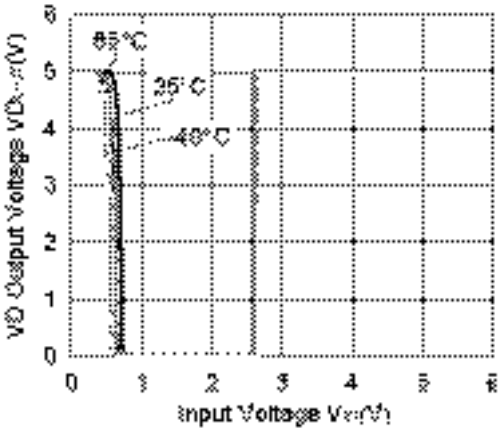
R5511x (–V_{DET}=4.3V 5.0V pull-up)



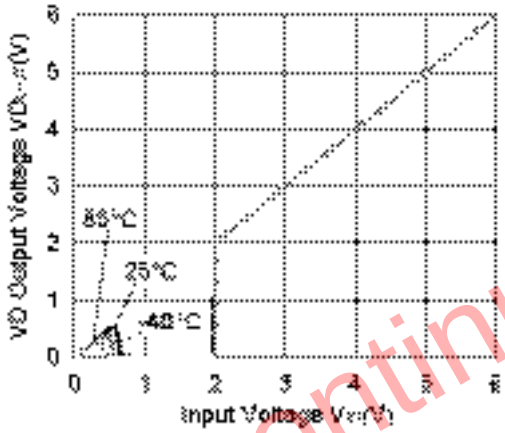
R5511x ($-V_{DET}$=2.63V V_{DD} pull-up)



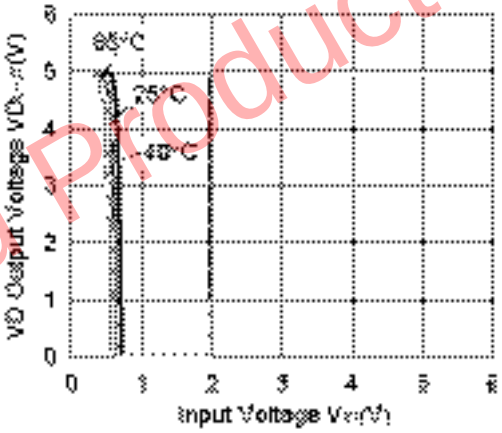
R5511x ($-V_{DET}$=2.63V 5.0V pull-up)



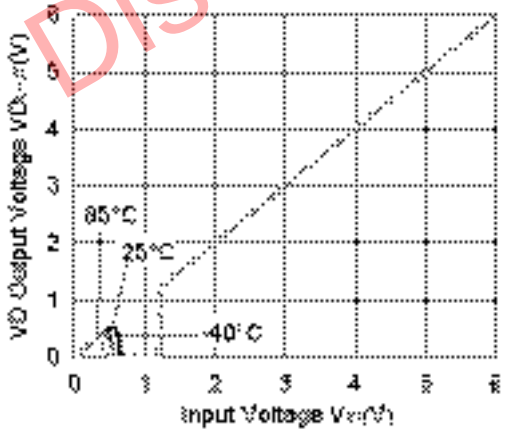
R5511x ($-V_{DET}$=2.0V V_{DD} pull-up)



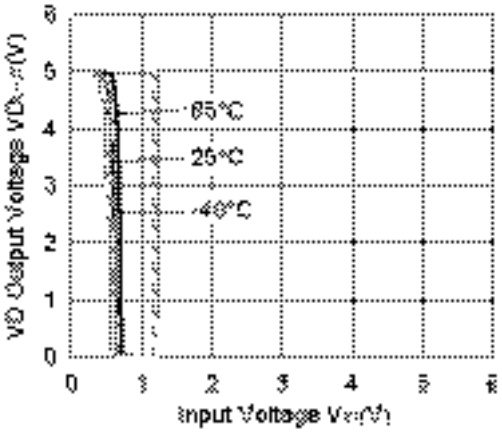
R5511x ($-V_{DET}$=2.0V 5.0V pull-up)



R5511x ($-V_{DET}$=1.2V V_{DD} pull-up)

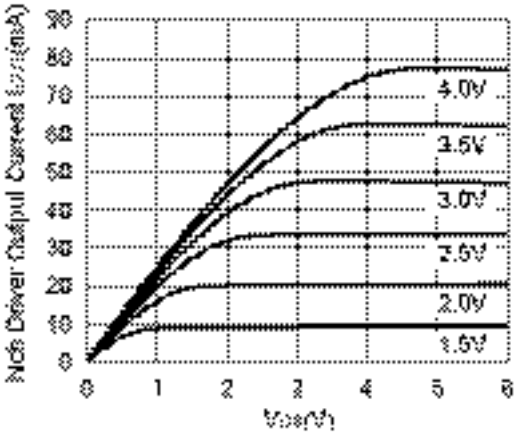


R5511x ($-V_{DET}$=1.2V 5.0V pull-up)

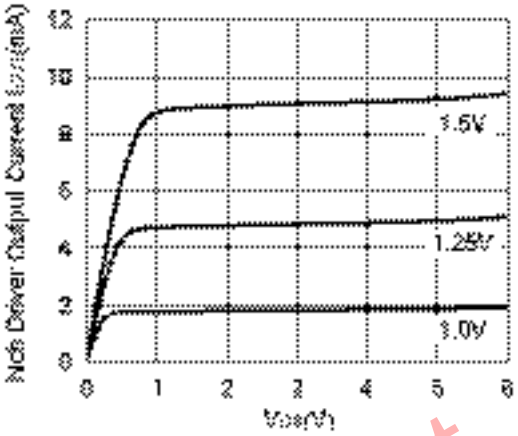


14) Nch Driver Output Current vs. V_{DS}

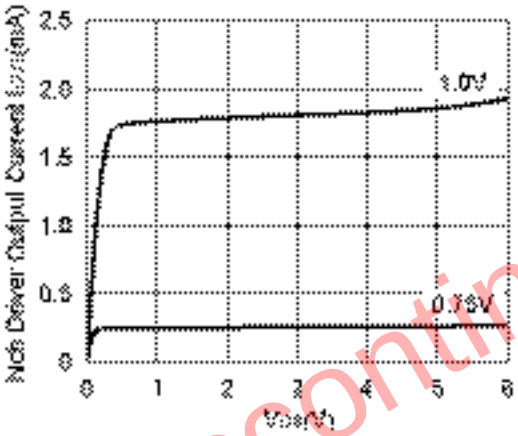
R5511x ($-V_{DET}$=4.3V)



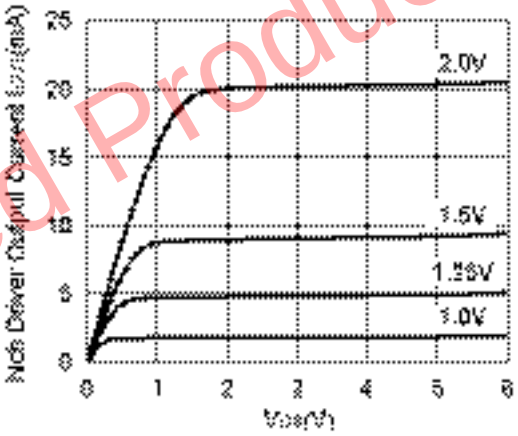
R5511x ($-V_{DET}$=2.0V)



R5511x ($-V_{DET}$=1.2V)

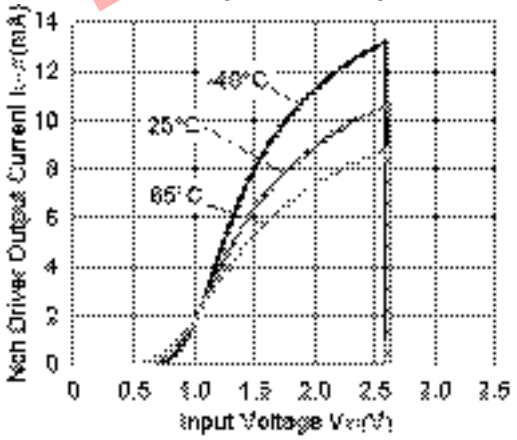


R5511x ($-V_{DET}$=2.63V)

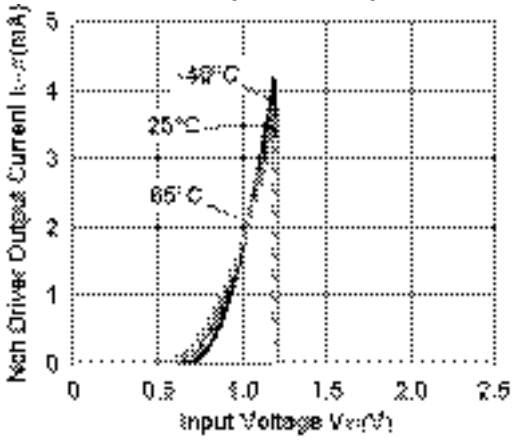


15) Nch Driver Output Current vs. Input Voltage

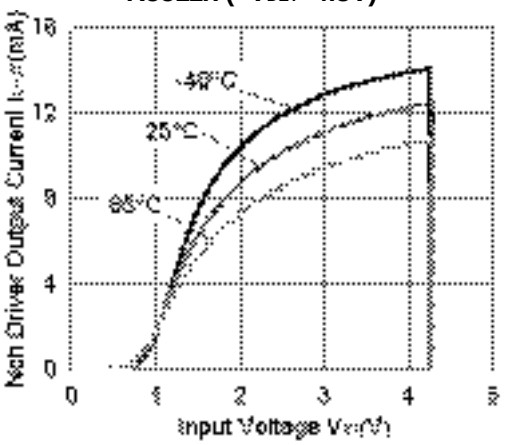
R5511x ($-V_{DET}$=2.63V)



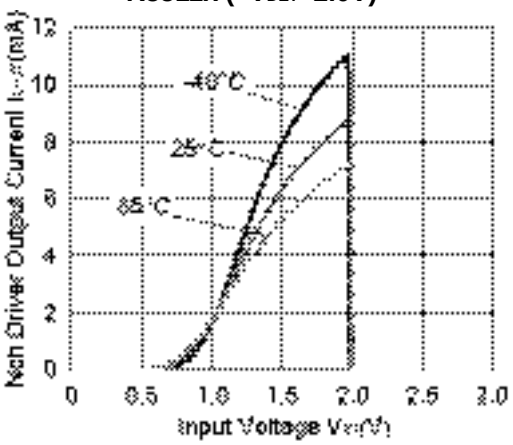
R5511x ($-V_{DET}$=1.2V)



R5511x (–V_{DET}=4.3V)

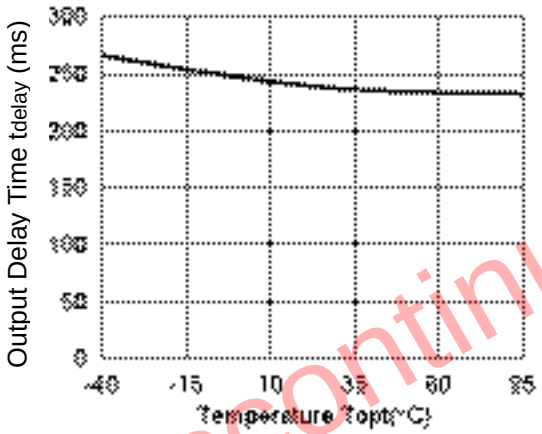


R5511x (–V_{DET}=2.0V)

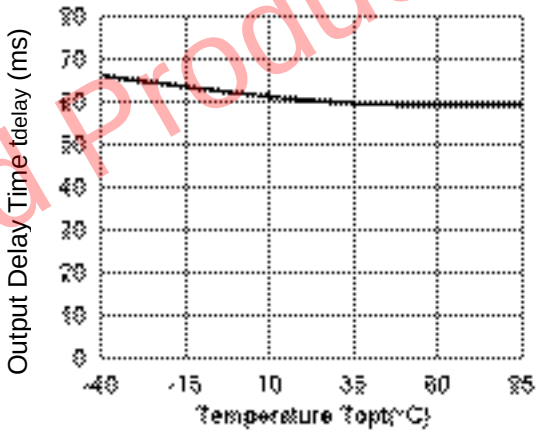


16) Output Delay Time vs. Temperature

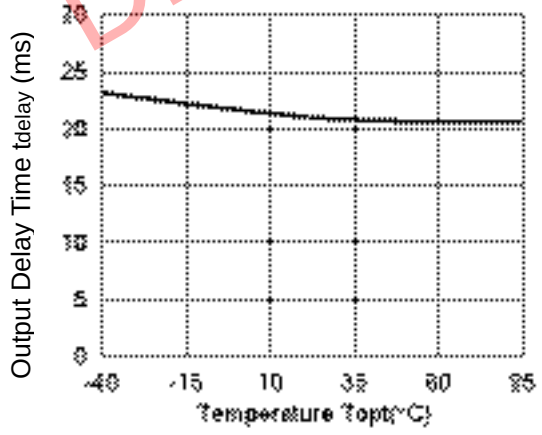
R5511x (t_{delay}=240ms)



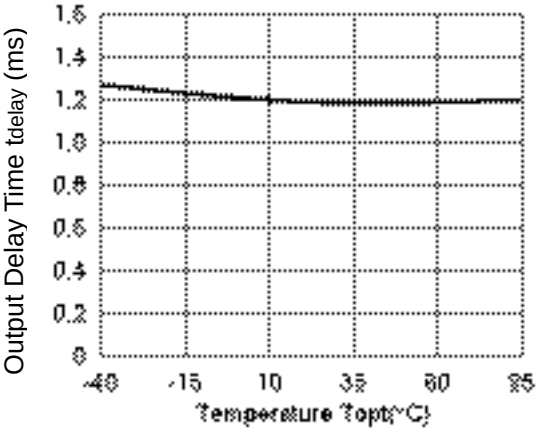
R5511x (t_{delay}=60ms)



R5511x (t_{delay}=20ms)



R5511x (t_{delay}=0ms)



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