XD6132 Series

ETR02043-002a

Delay capacitor adjustable voltage detectors with sense pin isolation, surge voltage protection and HYS external adjustment

☆AEC-Q100 Grade1

■GENERAL DESCRIPTION

The XD6132 series are ultra-small delay capacitor adjustable type voltage detectors that have high accuracy and sense pin isolation. High accuracy and a low supply current are achieved by means of a CMOS process, a highly accurate reference power supply, and laser trimming technology.

The sense pin is isolated from the power input pin to enable monitoring of the voltage of another power supply. Output can be maintained in the detection state even if the voltage of the power supply that is monitored drops to 0V. The sense pin is also suitable for detecting high voltages, and the detection and release voltage can be set as desired using external resistors. An internal surge voltage protection circuit and an internal delay circuit are also provided.

By connecting a capacitor to the Cd/MRB pin, any release delay time and detect delay time can be set and the pin can also be used as a manual reset pin.

The HYS external adjustment pin can be used to establish a sufficient hysteresis width.

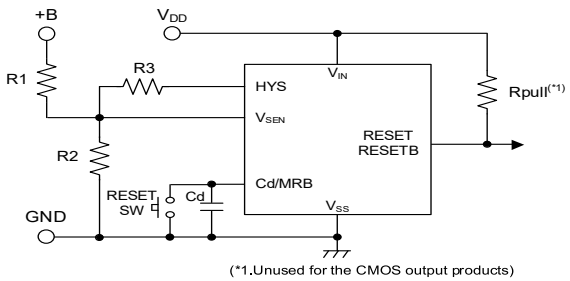
■APPLICATIONS

- ●Car navigation systems
- ●Car audios
- ●Automotive Camera
- ●Other automotive equipment

■FEATURES

Operating Ambient Temperature	: -40℃ ~ 125℃
Operating voltage range	: 1.6V ~ 6.0V
Detect voltage(Standard)	: 1.0V
Detect voltage range(Semi-custom)	: 0.8V ~ 2.0V
Detect voltage accuracy	: ±18mV(V_{DF}＜1.5V)
(Ta=25℃)	: ±1.2%(1.5V≦V_{DF}≦2.0V)
Detect voltage accuracy	: ±36mV(V_{DF}＜1.5V)
(Ta=-40~125℃)	: ±2.7%(1.5V≦V_{DF}≦2.0V)
Temperature Characteristics	: ±50ppm/℃(TYP.)
Hysteresis width	: V_{DF}×0.1%(TYP.)
Adjustable Pin for Hysteresis Width	: Yes
Low supply current	: 1.28μA(TYP.) V_{IN}=1.6V(At detection)
	: 1.65μA(TYP.) V_{IN}=6.0V(At release)
Manual reset function	: Yes (For details, refer to FUNCTION CHART)
Output type	: CMOS or Nch open drain
Output logic	: H level or L level at detection
Delay capacitance pin	: Release delay / detection delay can be set in 4 time ratio options (For details, refer to Selection Guide).
Sense pin	: Includes a surge voltage protection function
Packages	: USP-6C,SOT-26
Environment friendly	: EU RoHS compliant, Pb free

■TYPICAL APPLICATION CIRCUIT

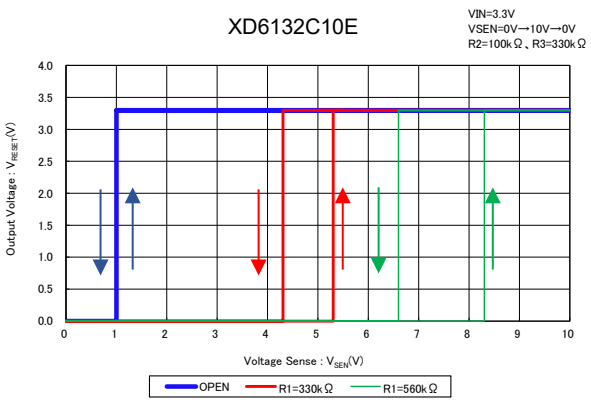


(*1.Unused for the CMOS output products)

Battery (+B) voltage monitoring: Detects high voltage via R1/R2 resistance division.

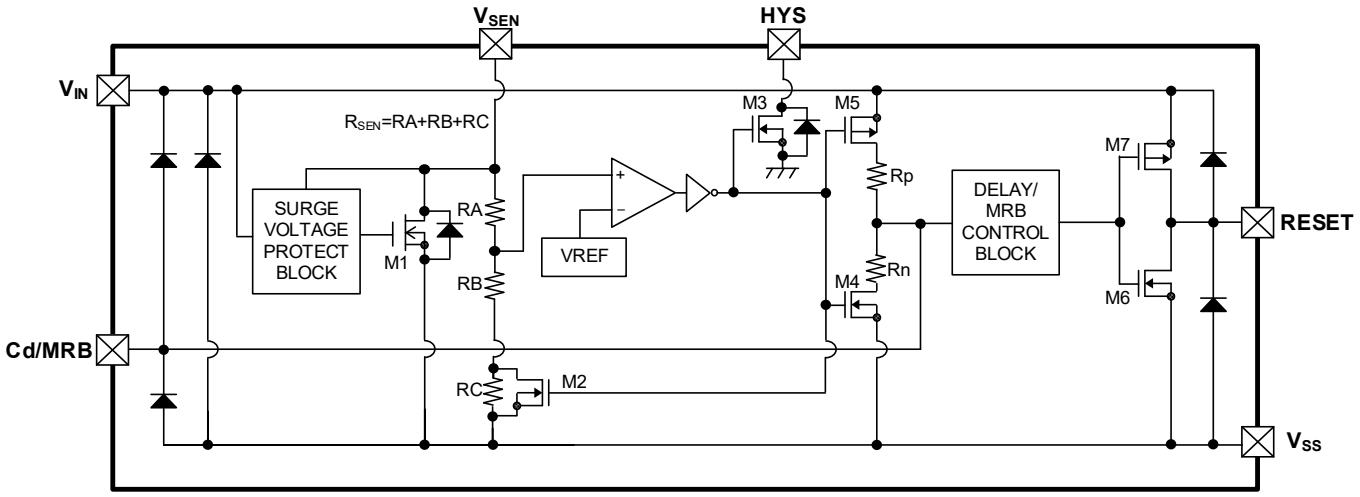
A hysteresis width can be added as desired by connecting R3 between the V_{SEN} and HYS pins (For details, refer to OPERATIONAL DESCRIPTION).

■TYPICAL PERFORMANCE CHARACTERISTICS



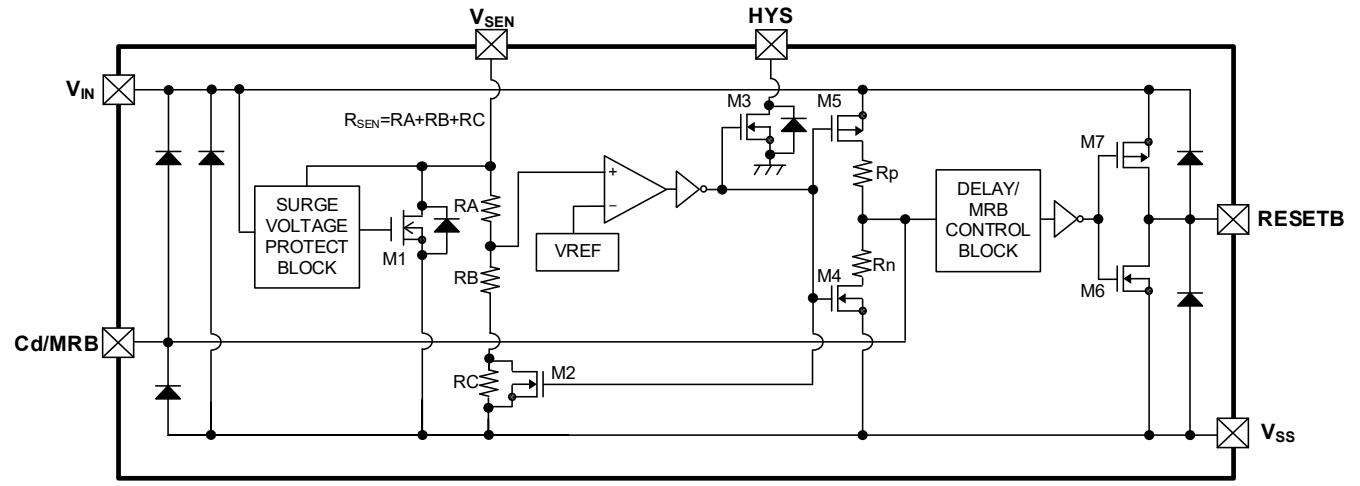
■BLOCK DIAGRAMS

(1)XD6132C Series A/B/C/D type (RESET OUTPUT: CMOS/Active High)



* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

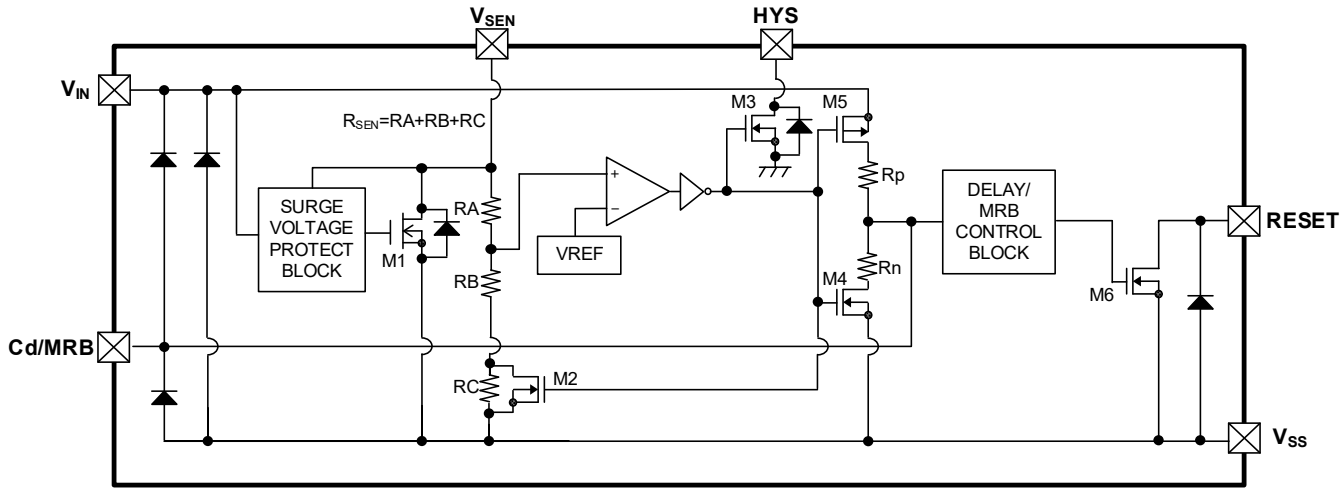
(2)XD6132C Series E/F/H/K type (RESETB OUTPUT: CMOS/Active Low)



* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

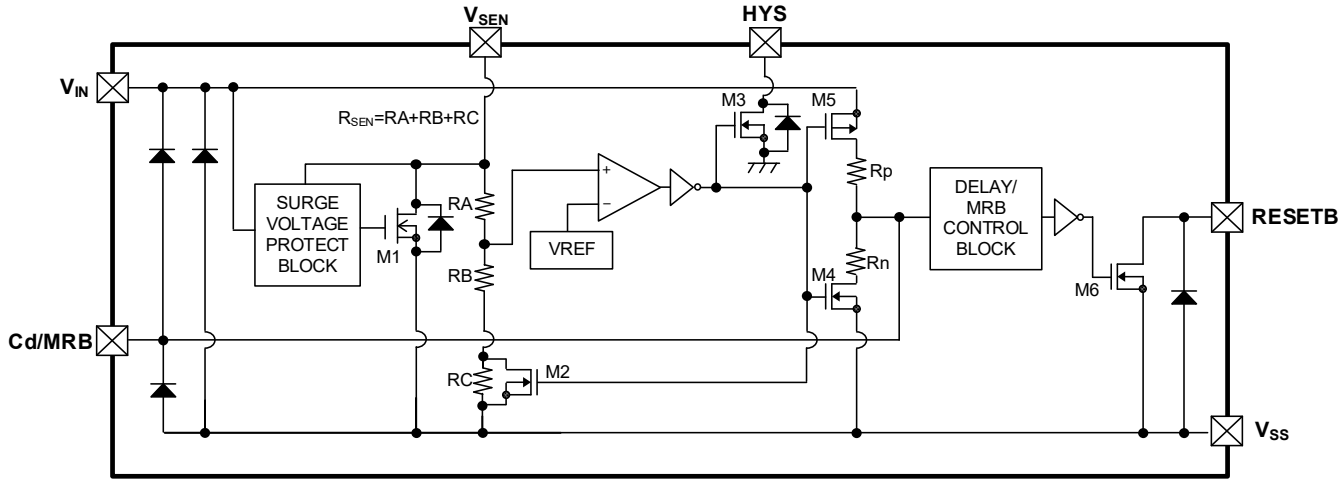
■BLOCK DIAGRAMS (Continued)

(3)XD6132N Series A/B/C/D type (RESET OUTPUT: Nch open drain/Active High)



* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

(4)XD6132N Series E/F/H/K type (RESETB OUTPUT: Nch open drain/Active Low)



* Diodes inside the circuit are an ESD protection diode and a parasitic diode.

■PRODUCT CLASSIFICATION

●Ordering Information

XD6132①②③④⑤⑥−⑦(*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Output Configuration	C	CMOS output
		N	Nch open drain output
②③	Detect Voltage	10(*2)	e.g. 1.0V → ②=1, ③=0
④	Type	A~K	Refer to Selection Guide
⑤⑥−⑦(*1)	Packages (Order Unit)	MR-Q	SOT-26 (3,000pcs/Reel)
		ER-Q	USP-6C (3,000pcs/Reel)

(*1) The "-Q" suffix denotes "AEC-Q100" and "Halogen and Antimony free" as well as being fully EU RoHS compliant.
(*2) For other output voltages, please contact your local Torex sales office or representative. The output voltage optional range is 0.8V to 2.0V.

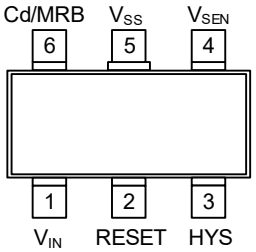
●Selection Guide

Part No.	Output Configuration	Detect Voltage	RESET/RESETB OUTPUT	DELAY(Rp:Rn)		HYSTERESIS
XD6132C10A	CMOS output	1.0V	Active High (*3)	1:0	144kΩ:0Ω	0.1% (TYP.)
XD6132C10B		↑	↑	1:0.125	144kΩ:18kΩ	↑
XD6132C10C		↑	↑	1:1	144kΩ:144kΩ	↑
XD6132C10D		↑	↑	2:1	288kΩ:144kΩ	↑
XD6132C10E		↑	Active Low (*3)	1:0	144kΩ:0Ω	↑
XD6132C10F		↑	↑	1:0.125	144kΩ:18kΩ	↑
XD6132C10H		↑	↑	1:1	144kΩ:144kΩ	↑
XD6132C10K		↑	↑	2:1	288kΩ:144kΩ	↑
XD6132N10A	Nch open drain output	↑	Active High (*3)	1:0	144kΩ:0Ω	↑
XD6132N10B		↑	↑	1:0.125	144kΩ:18kΩ	↑
XD6132N10C		↑	↑	1:1	144kΩ:144kΩ	↑
XD6132N10D		↑	↑	2:1	288kΩ:144kΩ	↑
XD6132N10E		↑	Active Low (*3)	1:0	144kΩ:0Ω	↑
XD6132N10F		↑	↑	1:0.125	144kΩ:18kΩ	↑
XD6132N10H		↑	↑	1:1	144kΩ:144kΩ	↑
XD6132N10K		↑	↑	2:1	288kΩ:144kΩ	↑

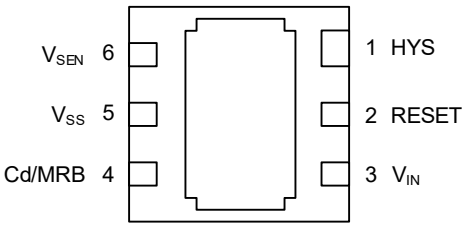
(*3) "Active High" is H level when detection occurs, and "Active Low" is L level when detection occurs.

■PIN CONFIGURATION

●A/B/C/D type

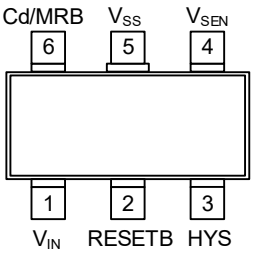


SOT-26
(TOP VIEW)

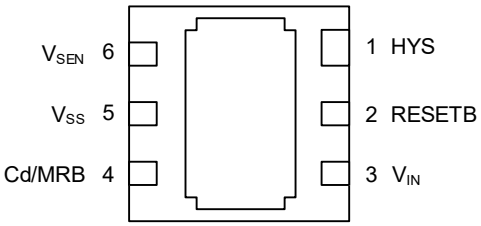


USP-6C
(BOTTOM VIEW)

●E/F/H/K type



SOT-26
(TOP VIEW)



USP-6C
(BOTTOM VIEW)

*The dissipation pad for the USP-6C package should be solder-plated in reference mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to V_{SS} (No.5) pin.

■PIN ASSIGNMENT

PIN NUMBER		PIN NAME	FUNCTIONS
SOT-26	USP-6C		
1	3	V_{IN}	Power Input
2	2	RESETB	Reset Output (Active Low)(*1)
		RESET	Reset Output (Active High)(*1)
3	1	HYS	Adjustable Pin for Hysteresis Width
4	6	V_{SEN}	Voltage Sense
5	5	V_{SS}	Ground
6	4	Cd/MRB	Adjustable Pin for Delay Time/ Manual Reset

(*1) Refer to the ④ in Ordering Information table.

■FUNCTION CHART

PIN NAME	SIGNAL	STATUS
Cd/MRB	L	Forced Reset
	H	For details, refer to " Function Chart "
	OPEN	Normal Operation

●Function Chart 1.6V≦V_{IN}≦6.0V

V_{SEN}	$V_{Cd/MRB}$	Transition of V_{RESETB} Condition	Transition of V_{RESET} Condition
		TYPE:A/B/C/D/L	TYPE:E/F/H/K/M
V_{SEN}≧V_{DF}+V_{HYS}	$V_{Cd/MRB}$≦V_{MRL}	Reset (High Level)(*2)	Reset (Low Level)(*1)
	$V_{Cd/MRB}$≧V_{MRH}	Release (Low Level)(*1)	Release (High Level)(*2)
V_{SEN}≦V_{DF}	$V_{Cd/MRB}$≦V_{MRL}	Reset (High Level)(*2)	Reset (Low Level)(*1)
	$V_{Cd/MRB}$≧V_{MRH}	Undefined(*3)	Undefined(*3)

(*1) CMOS output: V_{IN} × 0.1 or less, N-ch open drain output, pull-up voltage × 0.1 or less.
(*2) CMOS output: V_{IN} × 0.9 or higher, N-ch open drain output, pull-up voltage × 0.9 or higher.
(*3) For details,refer to ■OPERATIONAL DESCRIPTION＜Manual reset function＞.
Note: If used with V_{IN}＜V_{SEN}, the surge protection circuit will activate. Use with V_{IN}≧V_{SEN}.

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL		RATINGS	UNITS
Input Voltage		V_{IN}		-0.3 ~ 7.0	V
V_{SEN} Pin Voltage		V_{SEN}		-0.3 ~ V_{IN}+0.3 or 7.0(*1)	V
HYS Pin Voltage		V_{HYS}		-0.3~+7.0	V
Cd/MRB Pin Voltage		$V_{Cd/MRB}$		-0.3 ~ V_{IN}+0.3 or 7.0(*1)	V
Output Voltage	XD6132C(*2)	V_{RESETB}	V_{RESET}	-0.3 ~ V_{IN}+0.3 or 7.0(*1)	V
	XD6132N(*3)			-0.3 ~ 7.0	V
Cd/MRB Pin Current		$I_{Cd/MRB}$		±5.0	mA
Output Current	XD6132C(*2)	I_{RBOUT}	I_{ROUT}	±50	mA
	XD6132N(*3)			+50	mA
HYS Pin Current		I_{HYS}		+50	mA
V_{SEN} Pin Surge Current(+)		$I_{SENSURGE(+)}$		+2.5(*4)	mA
V_{SEN} Pin Surge Current(-)		$I_{SENSURGE(-)}$		-2.5(*5)	mA
V_{SEN} Pin Surge Voltage(+)		$V_{SENSURGE(+)}$		+7.0(*4)	V
V_{SEN} Pin Surge Voltage(-)		$V_{SENSURGE(-)}$		-0.9 (*5)	V
Power Dissipation	SOT-26	Pd		250	mW
				600 (40mm x 40mm Standard Board) (*6)	
	USP-6C			100	mW
				1250 (JESD51-7Board) (*6)	
Operating Ambient Temperature		Topr		-40~+125	℃
Storage Temperature		Tstg		-55~+125	℃

* All voltages are described based on the V_{SS}.
(*1) The maximum value should be either V_{IN}+0.3V or 7.0V in the lowest.
(*2) CMOS Output
(*3) N-ch Open Drain Output
(*4) Transient≦200ms.
(*5) Transient≦20ms.
(*6) The power dissipation figure shown is PCB mounted and is for reference only.
Please refer to PACKAGING INFORMATION for the mounting condition.

■ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS	Ta=25℃			-40℃≦Ta≦125℃(*3)			UNITS	CIRCUIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Operating Voltage	V_{IN}		1.6		6.0	1.6		6.0	V	①
V_{SEN} Input Voltage	V_{SEN}		0		6.0	0		6.0	V	
Detect Voltage	V_{DF}		0.982	1.000	1.018	0.964	1.000	1.036	V	
Hysteresis Width	V_{HYS}		-	V_{DF} ×0.001	V_{DF} ×0.007	-	V_{DF} ×0.001	V_{DF} ×0.01	V	
Supply Current 1	I_{ss1}	$V_{SEN}=V_{DF}\times0.9$, $V_{IN}=1.6V$	-	1.28	2.65	-	1.28	3.92	μA	②
		$V_{SEN}=V_{DF}\times0.9$, $V_{IN}=6.0V$	-	1.36	2.80	-	1.36	4.22		
Supply Current 2	I_{ss2}	$V_{SEN}=V_{DF}\times1.1$, $V_{IN}=1.6V$	-	1.32	2.75	-	1.32	4.26		
		$V_{SEN}=V_{DF}\times1.1$, $V_{IN}=6.0V$	-	1.65	3.25	-	1.65	4.97		
SENSE Resistance	R_{SEN}	$V_{IN}=6.0V, V_{SEN}=6.0V$	10.0	26.1	-	7.6	26.1	-	MΩ	③
Release Delay Resistance (TYPE:A/B/C/E/F/H)	Rp	$V_{IN}=6.0V, V_{SEN}=6.0V$, $V_{Cd/MRB}=0V$	130	144	158	122	144	166	kΩ	④
Release Delay Resistance (TYPE:D/K)		$V_{IN}=6.0V, V_{SEN}=6.0V$, $V_{Cd/MRB}=0V$	259	288	317	245	288	331		
Detect Delay Resistance (TYPE:C/D/H/K)	Rn	$V_{IN}=6.0V, V_{SEN}=0V$, $V_{Cd/MRB}=6.0V$	130	144	158	122	144	166		
Detect Delay Resistance (TYPE:B/F)		$V_{IN}=6.0V, V_{SEN}=0V$, $V_{Cd/MRB}=6.0V$	16.8	18	19.1	16.2	18	19.8		
Release Delay Time(*1)	t_{DR0}	$V_{IN}=6.0V$, $V_{SEN}=V_{DF}\times0.9\rightarrow V_{DF}\times1.1$	-	20	102	-	20	136	μs	⑤
Detect Delay Time(*2)	t_{DF0}	$V_{IN}=6.0V$, $V_{SEN}=V_{DF}\times1.1\rightarrow V_{DF}\times0.9$	-	20	82	-	20	116		

Unless otherwise specified in measurement conditions, Cd/MRB pin and HYS pin are open.
This specification is 1.0V product. For other nominal output voltages of Electrical characteristics, please contact your local Torex sales office or representative.

(*1) RESETB product: Time from when the V_{SEN} pin voltage reaches the release voltage until the reset output pin reaches 5.4V ($V_{IN}\times90\%$).
RESET product: Time from when the V_{SEN} pin voltage reaches the release voltage until the reset output pin reaches 0.6V($V_{IN}\times10\%$)
Release voltage (V_{DR})=Detect voltage (V_{DF})+Hysteresis width (V_{HYS}).

(*2) RESETB product: Time from when the V_{SEN} pin voltage reaches the detect voltage until the reset output pin reaches 0.6V($V_{IN}\times10\%$).
RESET product: Time from when the V_{SEN} pin voltage reaches the detect voltage until the reset output pin reaches 5.4V($V_{IN}\times90\%$).

(*3) The ambient temperature range (-40℃≦Ta≦125℃) is a design Value.

■ELECTRICAL CHARACTERISTICS (Continued)

PARAMETER	SYMBOL	CONDITIONS	Ta=25℃			-40℃≦Ta≦125℃(*5)			UNITS	CIRCUIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Hysteresis Output Current	I_{HYSOUT}	V_{IN}=1.6V, V_{SEN}=0V, V_{HYS}=0.3V	1.9	3.4	-	0.7	3.4	-	mA	⑥
Hysteresis Output Leakage Current	$I_{HYSLEAK}$	V_{IN}=6.0V, V_{SEN}=6.0V, V_{HYS}=6.0V	-	0.01	0.1	-	0.01	1.0	μA	
RESETB Output Current	I_{RBOUTN}	V_{SEN}=V_{DF}×0.9, Nch. V_{RESETB}=0.3V							mA	⑦
		V_{IN}=1.6V(*9)	1.9	3.4	-	0.7	3.4	-		
		V_{IN}=2.0V	4.2	6.0	-	2.0	6.0	-		
		V_{IN}=3.0V	8.6	10.5	-	4.3	10.5	-		
		V_{IN}=4.0V	12.7	14.1	-	6.2	14.1	-		
		V_{IN}=5.0V	15.6	17.0	-	7.3	17.0	-		
		V_{IN}=6.0V	17.8	19.2	-	8.1	19.2	-		
	I_{RBOUTP}	V_{SEN}=V_{DF}×1.1, Pch. V_{RESETB}=V_{IN}-0.3V								
		V_{IN}=1.6V(*10)	-	-1.2	-0.7	-	-1.2	-0.48		
		V_{IN}=3.0V	-	-3.0	-2.5	-	-3.0	-1.1		
		V_{IN}=6.0V	-	-4.9	-4.4	-	-4.9	-2.5		
RESET Output Current	I_{ROUTN}	V_{SEN}=V_{DF}×1.1, Nch. V_{RESET}=0.3V							mA	
		V_{IN}=1.6V(*10)	1.9	3.4	-	0.7	3.4	-		
		V_{IN}=2.0V(*11)	4.2	6.0	-	2.0	6.0	-		
		V_{IN}=3.0V	8.6	10.5	-	4.3	10.5	-		
		V_{IN}=4.0V	12.7	14.1	-	6.2	14.1	-		
		V_{IN}=5.0V	15.6	17.0	-	7.3	17.0	-		
		V_{IN}=6.0V	17.8	19.2	-	8.1	19.2	-		
	I_{ROUTP}	V_{SEN}=V_{DF}×0.9, Pch. V_{RESET}=V_{IN}-0.3V								
		V_{IN}=1.6V(*9)	-	-1.2	-0.7	-	-1.2	-0.48		
		V_{IN}=3.0V	-	-3.0	-2.5	-	-3.0	-1.1		
		V_{IN}=6.0V	-	-4.9	-4.4	-	-4.9	-2.5		
RESETB Output Leakage Current	I_{LEAKN}(*4)	V_{IN}=6.0V, V_{SEN}=6.0V, Nch. V_{RESETB}=6.0V	-	0.01	0.1	-	0.01	1.0	μA	
	I_{LEAKP}	V_{IN}=6.0V, V_{SEN}=0V, Pch. V_{RESETB}=0V	-	-0.01	-	-	-0.01	-		
RESET Output Leakage Current	I_{LEAKN}(*4)	V_{IN}=6.0V, V_{SEN}=0V, Nch. V_{RESET}=6.0V	-	0.01	0.1	-	0.01	1.0		
	I_{LEAKP}	V_{IN}=6.0V, V_{SEN}=6.0V, Pch. V_{RESET}=0V	-	-0.01	-	-	-0.01	-		

Unless otherwise specified in measurement conditions, Cd/MRB pin and HYS pin are open.

This specification is 1.0V product. For other nominal output voltages of Electrical characteristics, please contact your local Torex sales office or representative.

(*4) Max. value is for XD6132N (Nch open drain).

(*5) The ambient temperature range (-40℃≦Ta≦125℃) is a design Value.

■ELECTRICAL CHARACTERISTICS (Continued)

PARAMETER	SYMBOL	CONDITIONS	Ta=25℃			-40℃≦Ta≦125℃(*8)			UNITS	CIRCUIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Cd Pin Sink Current (TYPE:A/E)	I_{Cd}	V_{IN}=1.6V, $V_{Cd/MRB}$=0.5V, V_{SEN}=0V	0.92	1.2		0.66	1.2		mA	⑧
Cd Pin Threshold Voltage(Release)	V_{TCd1}	V_{IN}:Refer to V-1(*13), V_{SEN}=0V→V_{DF}×1.1	V_{IN}×0.46	V_{IN}×0.5	V_{IN}×0.54	V_{IN}×0.46	V_{IN}×0.5	V_{IN}×0.54	V	⑨
Cd Pin Threshold Voltage(Detect)	V_{TCd2}	V_{IN}:Refer to V-1(*13), V_{SEN}=V_{DF}×1.1→0V								
MRB High Level Voltage	V_{MRH}	V_{IN}:1.6V~6.0V, V_{SEN}= V_{DF}×1.1, V_{IN}>V_{SEN}	V_{IN}×0.55		V_{IN}	V_{IN}×0.55		V_{IN}	V	⑩
MRB Low Level Voltage	V_{MRL}	V_{IN}:1.6V~6.0V, V_{SEN}= V_{DF}×1.1, V_{IN}>V_{SEN}	0		V_{IN}×0.18	0		V_{IN}×0.18	V	
MRB Minimum Pulse Width	t_{MRIN}(*6)	V_{IN}=1.6V, V_{SEN}=V_{DF}×1.1, Apply pulse from V_{DF}×1.1 to 0V to the MRB pin.	5.0	-	-	5.0	-	-	μs	⑪
	t_{MRIN}(*7)		32.0	-	-	32.0	-	-		

Unless otherwise specified in measurement conditions, Cd/MRB pin and HYS pin are open.

This specification is 1.0V product. For other nominal output voltages of Electrical characteristics, please contact your local Torex sales office or representative.

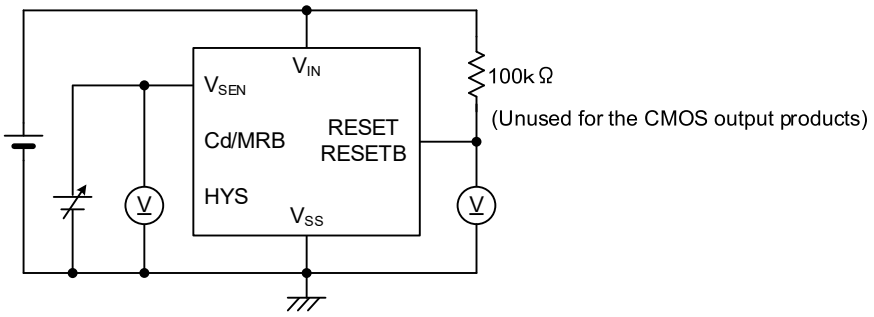
(*6) Specification is guaranteed for types A/B/C/D/E/F/H/K of the CMOS output product and types E/F/H/K of the Nch open drain product.

(*7) Specification is guaranteed for types A/B/C/D/L of the Nch open drain output product.

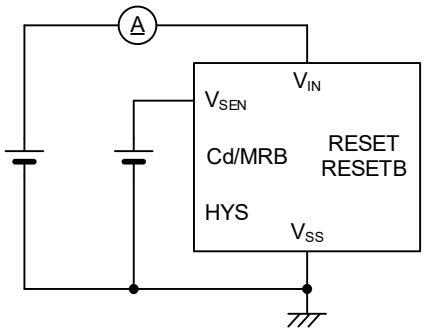
(*8) The ambient temperature range (-40℃≦Ta≦125℃) is a design Value.

■TEST CIRCUITS

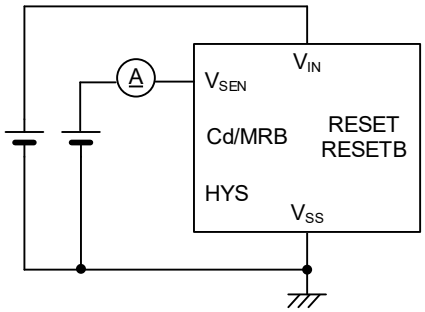
CIRCUIT①



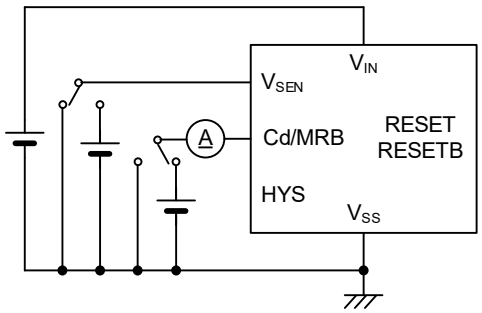
CIRCUIT②



CIRCUIT③



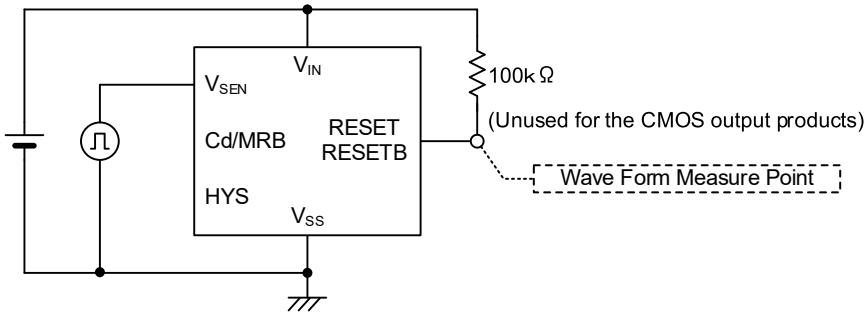
CIRCUIT④



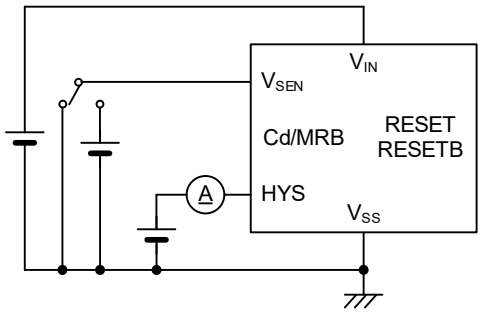
*“RESET” is A/B/C/D/L type, and “RESETB” is E/F/H/K/M type.

■TEST CIRCUITS (Continued)

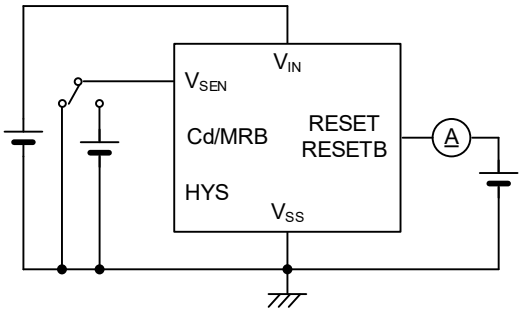
CIRCUIT⑤



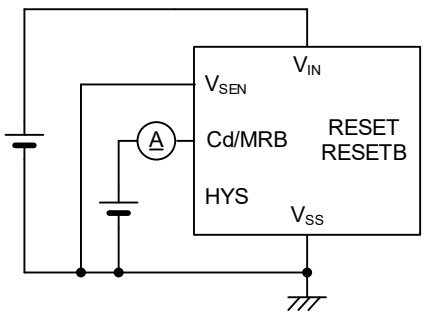
CIRCUIT⑥



CIRCUIT⑦



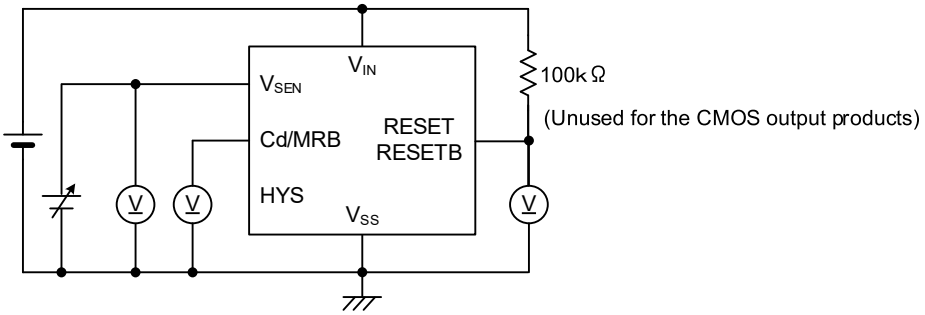
CIRCUIT⑧



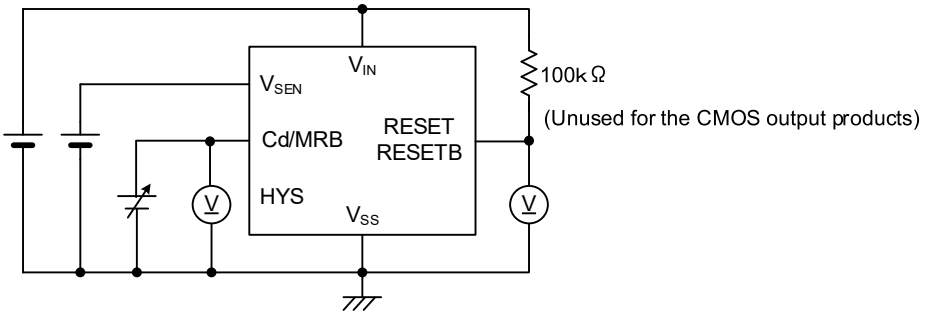
*“RESET” is A/B/C/D/L type, and “RESETB” is E/F/H/K/M type.

■TEST CIRCUITS (Continued)

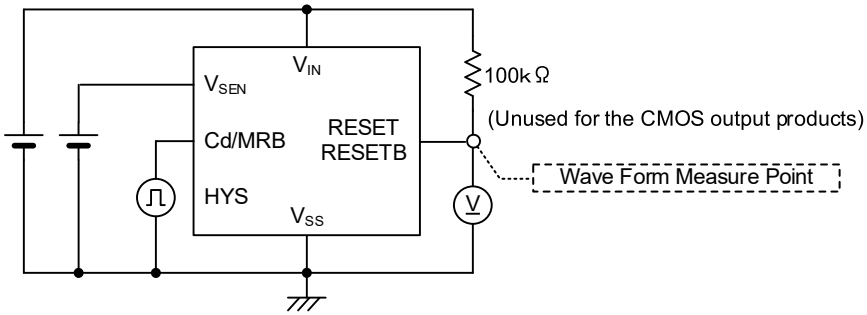
CIRCUIT⑨



CIRCUIT⑩



CIRCUIT⑪

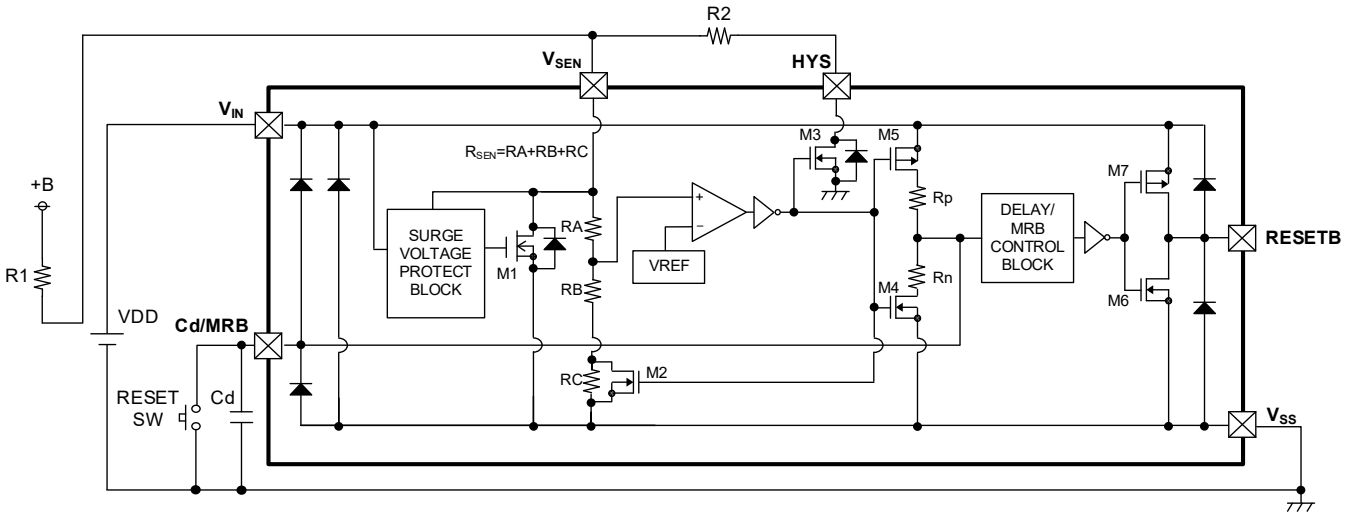


*“RESET” is A/B/C/D/L type, and “RESETB” is E/F/H/K/M type.

■OPERATIONAL DESCRIPTION

<Basic Operation>

Fig. 1 shows a typical block diagram. Fig. 2 shows the timing chart of Fig. 1.



* The XD6132N series (N-ch open drain output) requires a resistor to pull up the output.

Fig. 1: Typical block diagram (Active Low product)

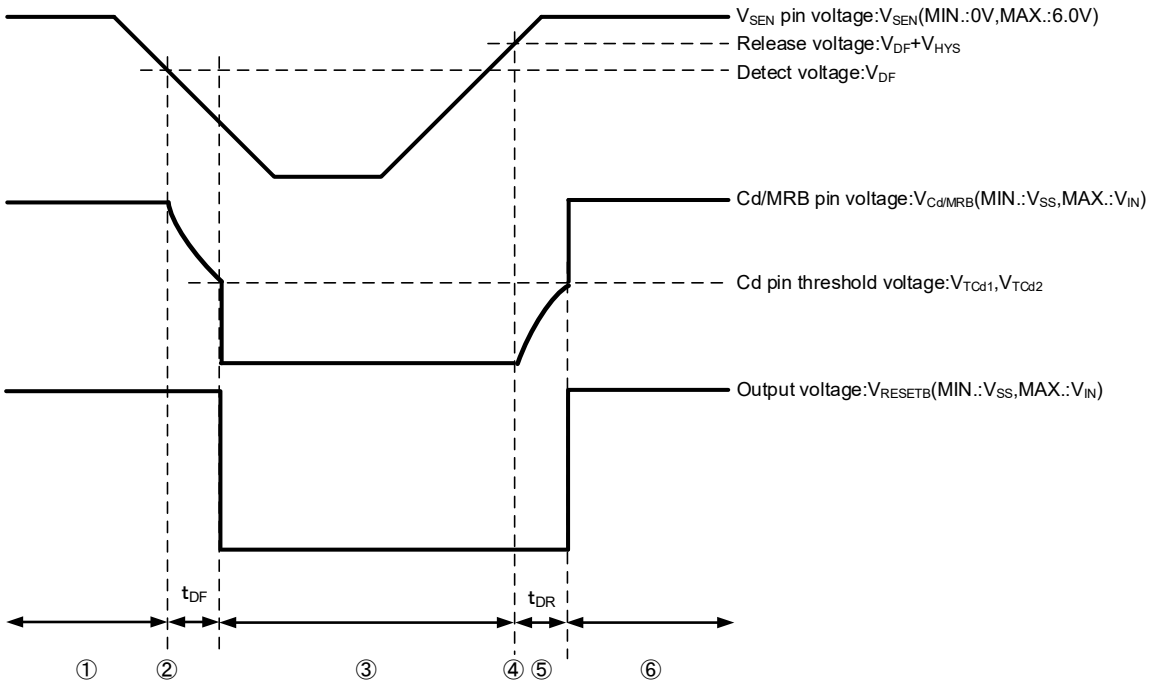


Fig. 2: Timing chart of Fig. 1(V_{IN}=6.0V、Active Low product)

①In the initial state, a voltage that is sufficiently high (MAX.:6.0V) with respect to the release voltage is applied to the V_{SEN} pin, and the delay capacitance Cd is charged up to the power input pin voltage.
The V_{SEN} pin voltage starts to fall, and during the time until it reaches the detect voltage (V_{SEN}＞V_{DF}),
V_{RESETB} is High level (=V_{IN}).

Note: If the pull-up resistor is connected to a power supply other than the power input pin V_{IN} when using the Nch open drain output (XD6132N), High level will be the voltage of the power supply to which the pull-up resistor is connected.

■OPERATIONAL DESCRIPTION (Continued)

②The V_{SEN} pin voltage continues to drop, and when it reaches the detect voltage ($V_{SEN}=V_{DF}$), the Nch transistor for delay capacitance discharge turns ON, and discharge of the delay capacitance Cd starts through the delay resistor Rn.
The time from $V_{SEN}=V_{DF}$ until V_{RESETB} reaches Low level is the detect delay time t_{DF} (the detect time when the capacitor is not connected to the Cd/MRB pin is t_{DF0}). The delay capacitance Cd is discharged through the delay resistor Rn when it is above the threshold voltage of V_{TCD2}. When it is below the threshold voltage of V_{TCD2}, the delay capacitance Cd is discharged faster through the internal built-in low impedance switch.

③During the time that the V_{SEN} pin voltage is below the detect voltage V_{DF}, the delay capacitance Cd discharges to ground level. The V_{SEN} pin starts rising again, and during the time until it reaches the release voltage ($V_{SEN}<V_{DF}+V_{HYS}$), V_{RESETB} holds Low level.

④The V_{SEN} pin voltage continues to rise, and when it reaches the release voltage ($V_{DF}+V_{HYS}$), the Nch transistor for delay capacitance discharge turns OFF, and charging of the delay capacitance Cd through the delay resistor Rp starts. The delay capacitance Cd is discharged through the delay resistor Rp when it is below the threshold voltage of V_{TCD1}. When it is above the threshold voltage of V_{TCD1}, the delay capacitance Cd is discharged faster through the internal built-in low impedance switch.

⑤When the delay capacitance pin voltage reaches V_{TCd1}, V_{RESETB} changes to High level.
The time from $V_{SEN}=V_{DF}+V_{HYS}$ until the V_{RESETB} logic changes is the release delay time t_{DR}(the release time when the capacitor is not connected to the Cd/MRB pin is t_{DR0}).

⑥During the time that the V_{SEN} pin voltage is higher than the detect voltage ($V_{SEN}>V_{DF}$), V_{RESETB} holds High level.
The above operation description is for an Active Low detection product.
For an Active High product, reverse the logic of the reset pin.
In the factory shipping state, internal hysteresis is not added ($V_{HYS}=V_{DF}$x0.001V(TYP.)), so please add a hysteresis of 1% or more with an external resistor. For the calculation method, refer to <Hysteresis external adjustment function> below. Also please refer to “Notes on use 5&6” on page 19.

<Hysteresis external adjustment function>
Hysteresis can be added as desired by inserting a resistor between the node to monitor and V_{SEN} pin, and between the V_{SEN} pin and HYS pin.
The calculation method for adding hysteresis by increasing only the release voltage and leaving the detect voltage unchanged is given below.
For the circuit schematic, refer to Fig. 3: Hysteresis Augmentation Circuit 1.

$V_{DR}(H)=V_{DR}(T)\times\{1+(RD/RE)\}$
Hysteresis width=$V_{DR}(H)-V_{DF}(T)$

Example 1: RD=200kΩ, RE=200kΩ, $V_{DF}(T)$=1.000V, $V_{DR}(T)$=1.001V.
$V_{DR}(H)$=2.002V
Hysteresis width=2.002-1.000 =1.002V

The calculation method for detecting high voltage and adding hysteresis is shown below.
For the circuit schematic, refer to Fig. 4: Hysteresis Augmentation Circuit 2.
$V_{DF}(H)=V_{DF}(T)\times\{1+(R1/R2)\}$
$V_{DR}(H)=V_{DR}(T)\times\{1+(R1/R2)+(R1/R3)\}$
Hysteresis width=$V_{DR}(H)-V_{DF}(H)$

Example 2: R1=R3=500kΩ, R2=200kΩ, $V_{DF}(T)$=2.000V, $V_{DR}(T)$=2.002V.
$V_{DF}(H)$=7.0V
$V_{DR}(H)$=9.00.9
Hysteresis width=9.009-7.0=2.009V

(Note 1) $V_{DF}(H)$ is the detect voltage after external adjustment.
(Note 2) $V_{DR}(H)$ is the release voltage after external adjustment.
(Note 3) $V_{DR}(T)$ is the release voltage.
(Note 4) $V_{DF}(T)$ is the detect voltage.
(Note 5) The R2 resistance is in parallel with the internal R_{SEN} resistance, and thus to increase the accuracy of the detect voltage and release voltage after external adjustment, select an R2 resistance that is sufficiently small with respect to the R_{SEN} resistance. For R_{SEN} resistance values, refer to SPEC TABLE (p.11).
(Note 6) If high voltage is to be detected, divide the voltage with resistors R1 and R2 so that V_{SEN} pin≦6V. The battery voltage (+B) assumes up to 12V in this case.

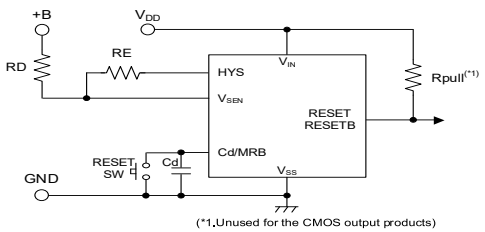


Fig. 3: Hysteresis Augmentation Circuit 1

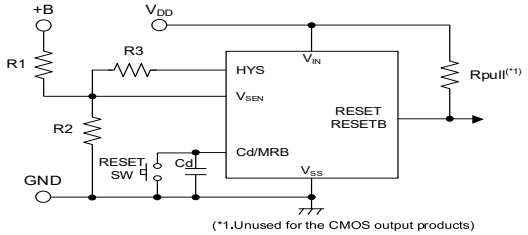


Fig. 4: Hysteresis Augmentation Circuit 2

■OPERATIONAL DESCRIPTION (Continued)

<Release delay time / detect delay time>

The release delay time and detect delay time are determined by the delay resistors (Rp and Rn) and the delay capacitance Cd. The ratio of the delay resistances (Rp and Rn) is selectable from 5 options. The delay time is adjustable using the combination of delay resistance and delay capacitance value. (Refer to “Selection Guide”)

The release delay time (t_{DR}) is calculated using Equation (1).

$$t_{DR}=Rp\times Cd\times\{-\ln(1-V_{TCd1}/V_{IN})\}+t_{DR0} \quad \ldots(1)$$ * ln is the natural logarithm.

The delay capacitance pin threshold voltage is $V_{TCd1}=V_{IN}/2$(TYP.), and thus when t_{DR0} can be neglected, the release delay time can be calculated simply using Equation (2).

$$t_{DR}=Rp\times Cd\times[-\ln\{1-(V_{IN}/2)/V_{IN}\}]=Rp\times Cd\times 0.693 \quad \ldots(2)$$

The detect delay time (t_{DF}) is calculated using Equation (3).

$$t_{DF}=Rn\times Cd\times\{-\ln(V_{TCd2}/V_{IN})\}+t_{DF0} \quad \ldots(3)$$ * ln is the natural logarithm.

The delay capacitance pin threshold voltage is $V_{TCd2}=V_{IN}/2$ (TYP.), and thus when t_{DF0} can be neglected, the detect delay can be calculated simply using Equation (4).

$$t_{DF}=Rn\times Cd\times\{-\ln(V_{IN}/2)/V_{IN}\}=Rn\times Cd\times 0.693 \quad \ldots(4)$$

Example 3: When type A is selected (Rp : Rn=144kΩ : 0Ω),the delay times are as follows:

If Cd is set to 0.1uF,

$t_{DR}=144\times10^{3}\times0.1\times10^{-6}\times0.693=10ms$

t_{DF} is the detect delay time (t_{DFO}) when the delay capacitance Cd is not connected.

Example 4: When type B is selected (Rp : Rn=144kΩ : 18kΩ),the delay times are as follows:

If Cd is set to 0.1uF,

$t_{DR}=144\times10^{3}\times0.1\times10^{-6}\times0.693=10ms$

$t_{DF}=18\times10^{3}\times0.1\times10^{-6}\times0.693=1.25ms$

(Note 7) The release delay times t_{DR} in Examples 3 and 4 are the values calculated from Equation (2).
(Note 8) The detect delay time t_{DF} in Example 4 is the value calculated from Equation (4).
(Note 9) Note that the delay times will vary depending on the actual capacitance value of the delay capacitance Cd.

<Manual reset function>

The Cd/MRB pin can also be used as a manual reset pin.

When the Cd and RESET switch are connected to the Cd/MRB pin (refer to Fig.1), and under the release condition, if the RESET switch turns on, then the detect signal is generated at the RESET/RESETB pin forcibly.

For Active Low type (RESETB), under the release condition, if the RESET switch turns on, then the voltage at the RESETB pin changes from H to L after the detect delay time.

For Active High type (RESET), under the release condition, if the RESET switch turns on, then the voltage at the RESET pin changes from L to H after the detect delay time.

Under the detect condition, the condition will be kept even if the RESET switch turns on and off.

In the case that either H level or L level is fed to the Cd/MRB pin without the RESET switch, the behavior of the XD6132 follows the timing chart in Fig. 5.

L level is fed to the MRB pin under the detect condition, the RESET switch will be kept.
H level is fed to the MRB pin under the detect condition, the RESET switch will be undefined.

Even though the voltage at the V_{SEN} pin changes from a higher voltage than the detect voltage to a lower voltage, as long as H level is fed to the MRB pin, the release condition is kept.

If H level or L level is fed to the Cd/MRB pin forcibly, then even though Cd is connected to the pin, the XD6132 can’t have any delay time.

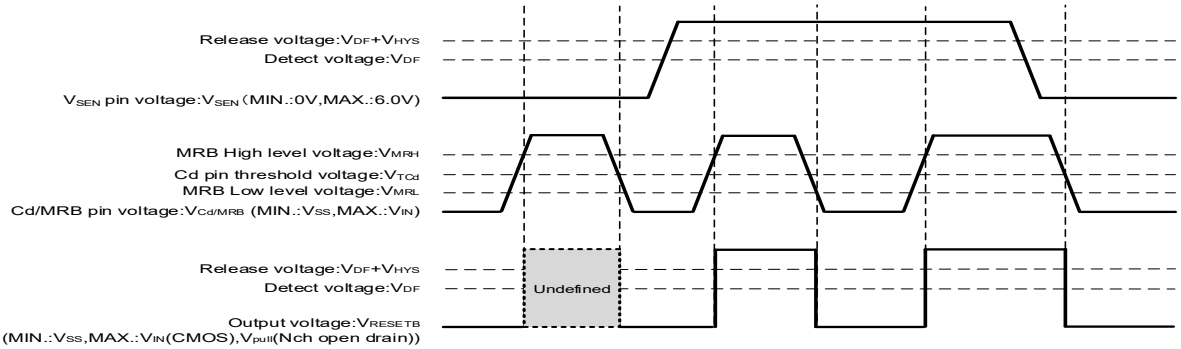


Fig. 5: Manual reset operation using the Cd/MRB pin (V_{IN} =6.0V, Active Low product)

■OPERATIONAL DESCRIPTION (Continued)

<Surge voltage protection function>

A surge voltage protection circuit is incorporated into the V_{SEN} pin. A surge current of +2.5mA(≧200ms), -2.5mA(≧20ms) is possible.

A positive surge current ($I_{SENSURGE(+)}$) flows when M1 is turned ON by a SURGE VOLTAGE PROTECT BLOCK signal.
A negative surge current ($I_{SENSURGE(-)}$) is made to flow by the M1 parasitic diode.
When a positive surge current flows and the surge voltage protection circuit activates, the V_{SEN} pin voltage rises in proportion to the V_{IN} voltage and surge current, so adjust the I_{SEN} current with an external resistor so that the V_{SEN} pin voltage does not exceed the operating voltage. Refer to Fig. 7.
※The V_{SEN} voltage rise is most pronounced at high temperature.

Example 5: When V_{IN}=3.3V and $I_{SENSURGE(+)}$=2.5mA (MAX), the V_{SEN} pin voltage from Fig. 7 is 5.6V. If the maximum battery voltage (+B) pin voltage is 100V, a voltage of (100-5.6)=94.4V will be applied to the R1 resistor. To keep the surge current from exceeding 2.5mA, use a resistance of R1=V/I=94.4/0.0025=37.8kΩ or above.

Example 6: When V_{IN} = 3.3V and $I_{SENSURGE(-)}$ = -2.5mA(MAX), Vf of the parasitic diode M1 is -0.9V (MAX).
If the battery voltage (+B) maximum is -100V, the voltage applied to the R1 resistor will be {-100 - (-0.9)} = -99.1V.
To limit the surge current to -2.5mA, set the R1 resistance to R1 = V/I= -99.1/-0.0025 = 39.6kΩ or higher.

If the surge voltage on the positive side is different from the negative side, calculate the R1 resistance value using the side where the voltage difference applied to the R1 resistor is greatest.

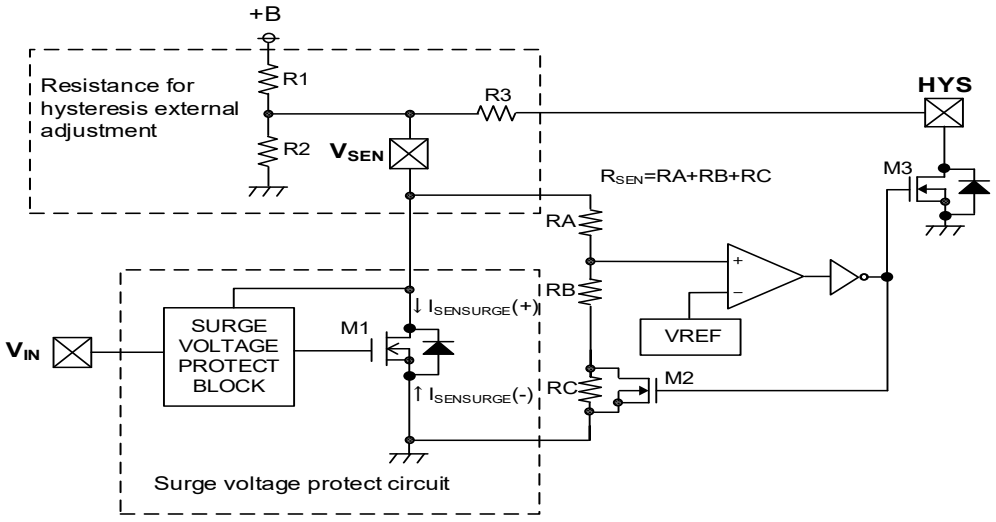


Fig. 6: Surge voltage protect circuit

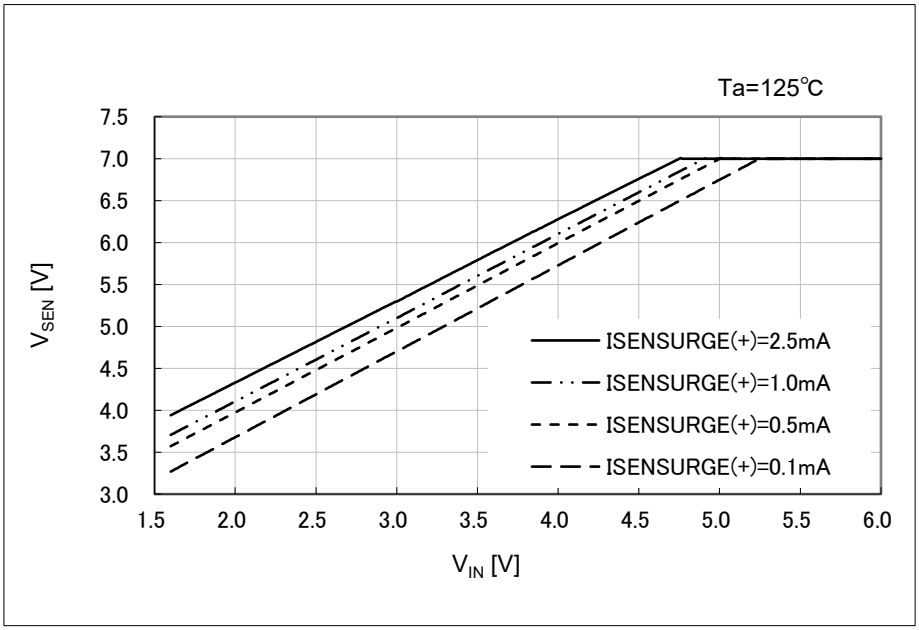


Fig. 7: Example of V_{IN}-V_{SEN} characteristics

■NOTES ON USE

1) Please use this IC within the stated maximum ratings. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.

2) The power input pin voltage may fall due to the flow through current during IC operation and the resistance component between the power supply and the power input pin.
In the case of CMOS output, a drop in the power input pin voltage may occur in the same way due to the output current. When this happens, if the power input pin voltage drops below the minimum operating voltage, a malfunction may occur.

3) Note that large, sharp changes of the power input pin voltage may lead to malfunction.

4) Power supply noise is sometimes a cause of malfunction. Sufficiently test using the actual device, such as inserting a capacitor between V_{IN} and GND.

5) Internal hysteresis is not initially included with the product. Connect external resistors to the V_{SEN} pin and HYS pin to add a hysteresis of 1% or more. Note that if hysteresis is not added with external resistors, oscillation will occur when switching takes place at the detect voltage or the release voltage.

6) There is a possibility that oscillation will occur if the resistances of the V_{SEN} pin and HYS pin are high. Use a resistance of 1MΩ or less between the node to monitor and V_{SEN} pin, and between the V_{SEN} pin and HYS pin.

7) Exercise caution if V_{IN} and V_{SEN} are started in common, as the output will be undefined until V_{IN} reaches the operating voltage.

8) For a manual reset function, in case when the function is activated by feeding either MRB H level or MRB L level to Cd/MRB pin instead of using a reset switch, please note these phenomena below;
・The RESET output signal will be undefined when MRB H is fed to Cd/MRB pin under the detect condition.
・The RESET output signal will be undefined based on the voltage relationship between V_{SEN} pin and Cd/MRB pin.

9) When an N-ch open drain output is used, the V_{RESETB} voltage at detection and release is determined by the pull-up resistance connected to the output pin. Refer to the following when selecting the resistance value.

At detection:

$V_{RESETB}=V_{pull}/(1+R_{pull}/R_{ON})$

V_{pull} : Voltage after pull-up

R_{ON}(*1) : ON resistance of N-ch driver M6 (calculated from V_{RESETB}/I_{RBOUTN} based on electrical characteristics)

Example: When V_{IN}=2.0V(*2), $R_{ON}=0.3/4.2\times10^{-3}$=71.4Ω (MAX.).

If it is desired to make V_{RESETB} at detection 0.1V or less when V_{pull} is 3.0V,

$R_{pull}=\{(V_{pull}/V_{RESETB})-1\}\times R_{ON}=\{(3/0.1)-1\}\times71.4\fallingdotseq2.1k\Omega$

Therefore, to make the output voltage at detection 0.1V or less under the above conditions, the pull-up resistance must be 2.1kΩ or higher.

(*1) Note that R_{ON} becomes larger as V_{IN} becomes smaller.

(*2) For V_{IN} in the calculation, use the lowest value of the input voltage range you will use.

At release:

$V_{RESETB}=V_{pull}/(1+R_{pull}/R_{off})$

V_{pull}: Voltage after pull-up

R_{off}: Resistance when N-ch driver M6 is OFF (calculated from V_{RESETB}/I_{LEAKN} based on electrical characteristics)

Example: When V_{pull} is 6.0V, $R_{off}=6/(0.1\times10^{-6})$=60MΩ (MIN.). If it is desired to make V_{RESETB} 5.99V or higher,

$R_{pull}=\{(V_{pull}/V_{RESETB})-1\}\times R_{off}=\{(6/5.99)-1\}\times60\times10^{6}\fallingdotseq100k\Omega$

Therefore, to make the output voltage at release 5.99V or higher under the above conditions, the pull-up resistance must be 100kΩ or less.

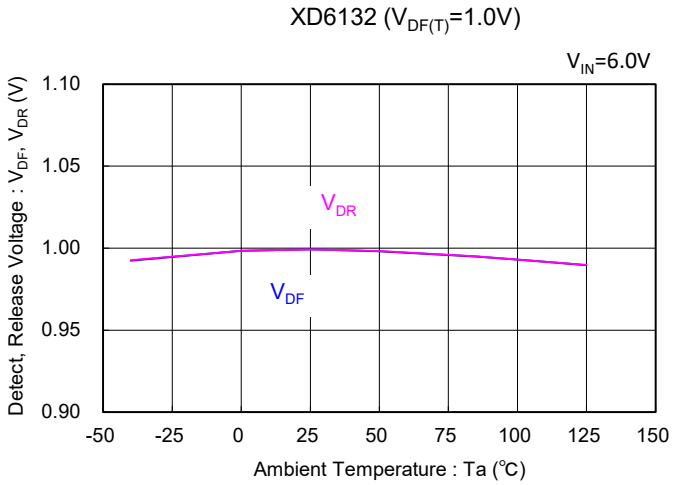
10) If the discharge time of the delay capacitance Cd at detection is short and the delay capacitance Cd cannot be discharged to ground level, charging will take place at the next release operation with electric charge remaining in the delay capacitance Cd, and this may cause the release delay time to become noticeably short.

11) If the charging time of the delay capacitance Cd at release is short and the delay capacitance Cd cannot be charged to the V_{IN} level, the delay capacitance Cd will discharge from less than the V_{IN} level at the next detection operation, and this may cause the detect delay time to become noticeably short.

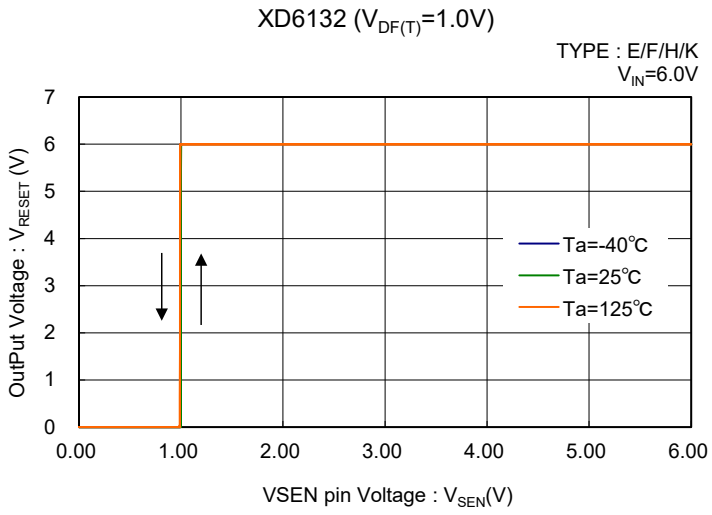
12) Torex places an importance on improving our products and their reliability. We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.

■TYPICAL PERFORMANCE CHARACTERISTICS

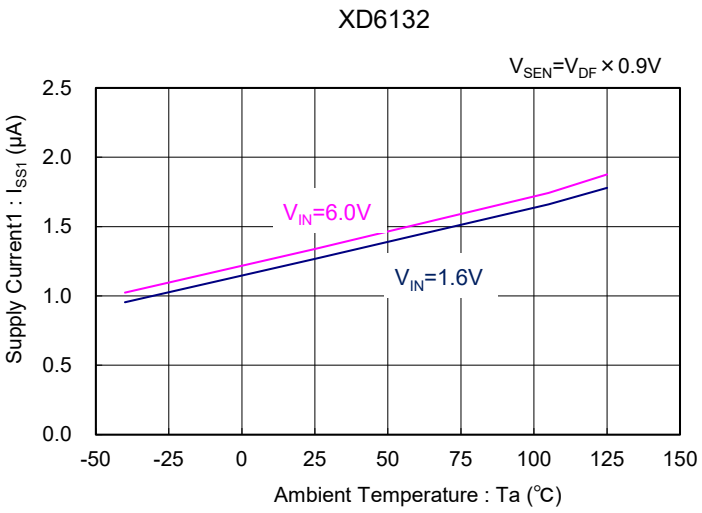
(1) Detect, Release Voltage vs. Ambient Temperature

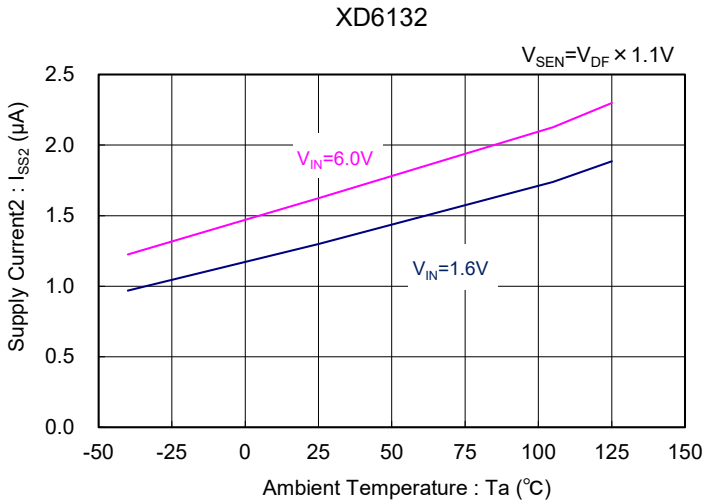


(2) Output Voltage vs Sense Voltage

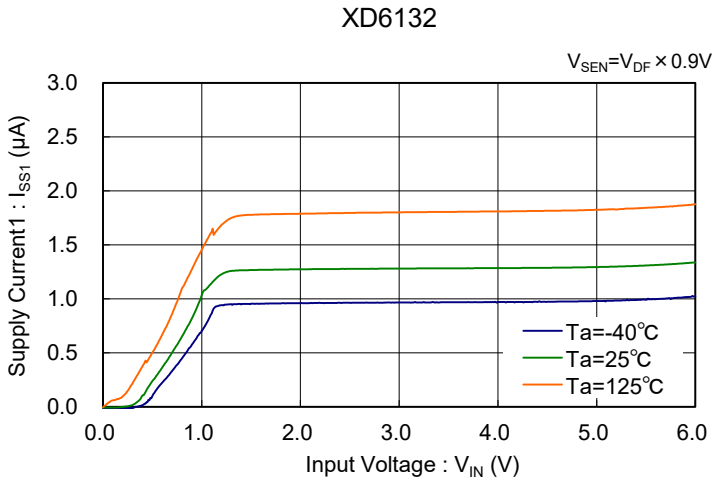


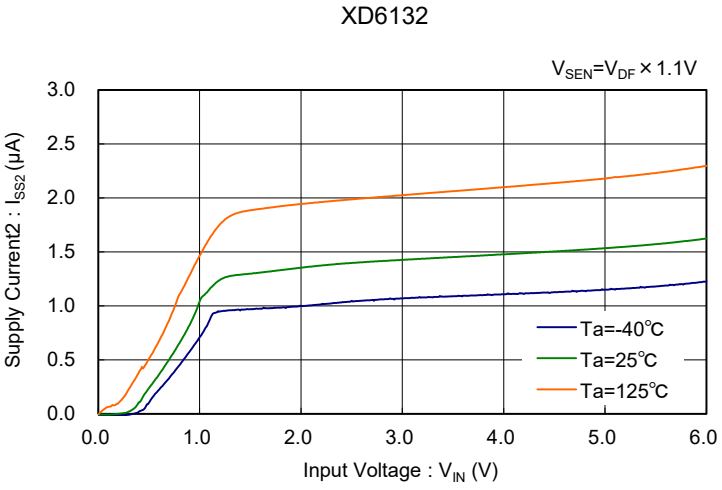
(3) Supply Current vs. Ambient Temperature





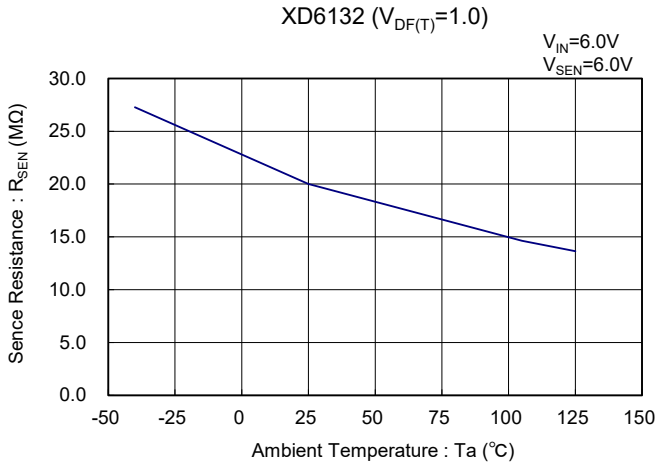
(4) Supply Current vs. Input Voltage



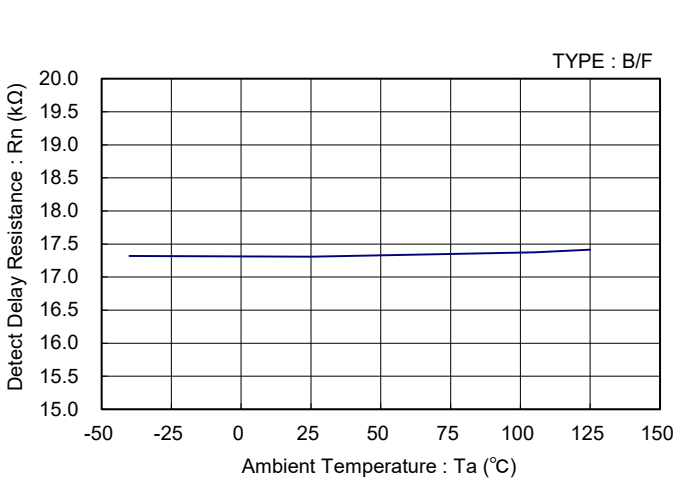


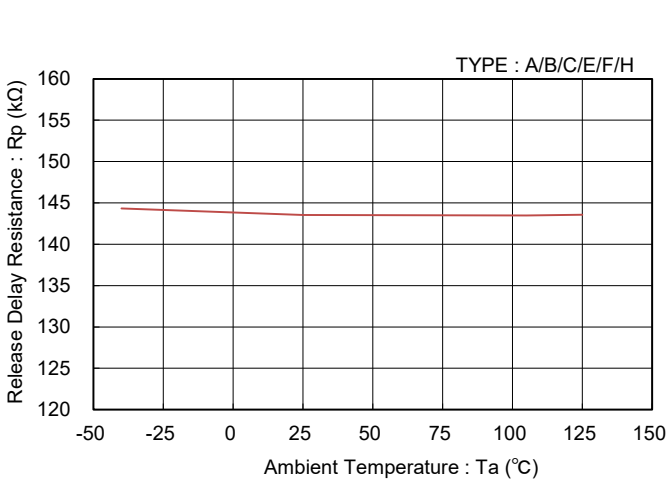
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

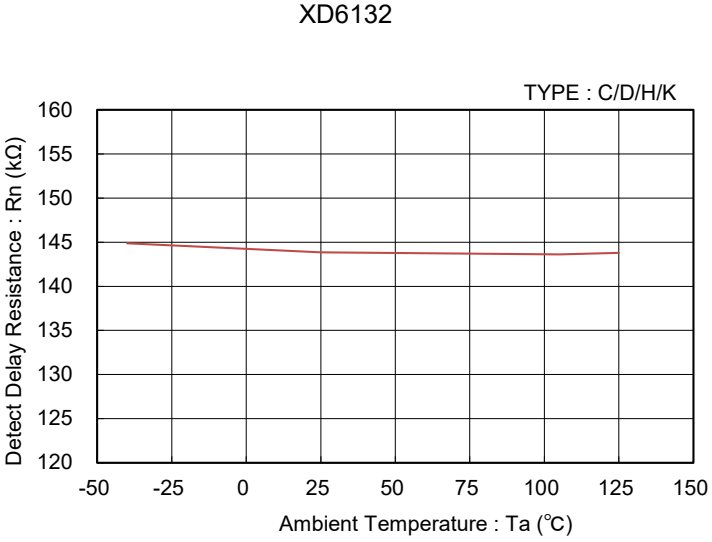
(5) Sense Resistance vs Ambient Temperature

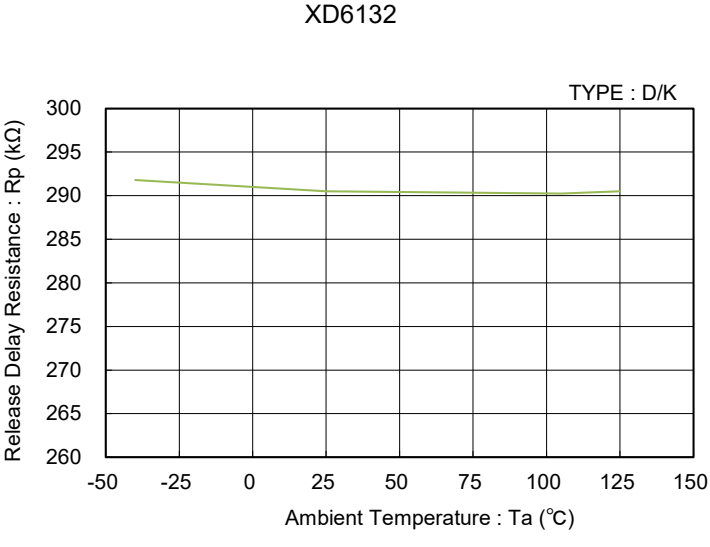


(6) Delay Resistance vs Ambient Temperature



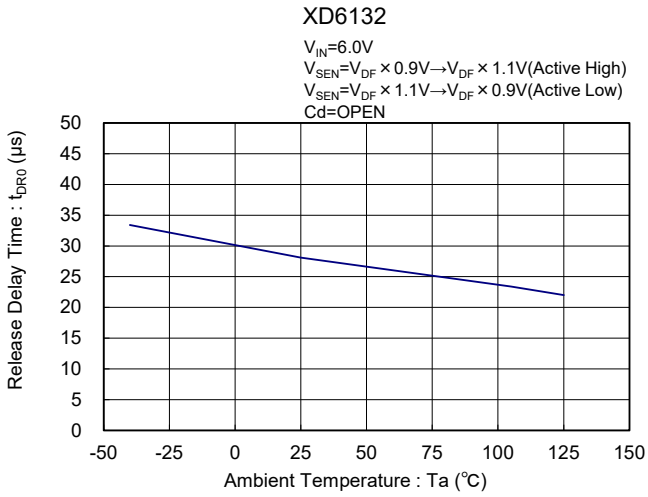


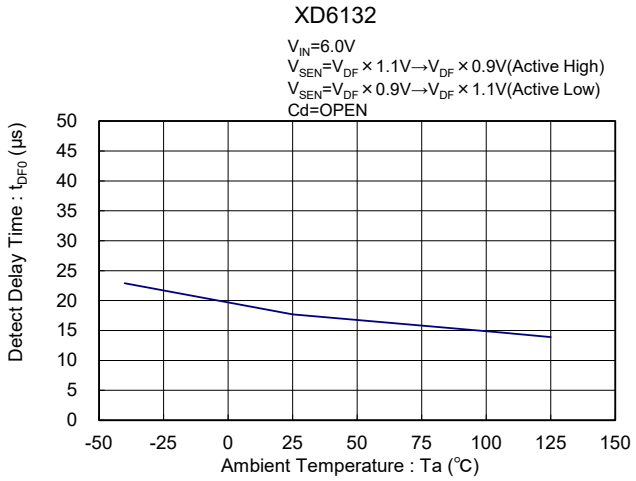




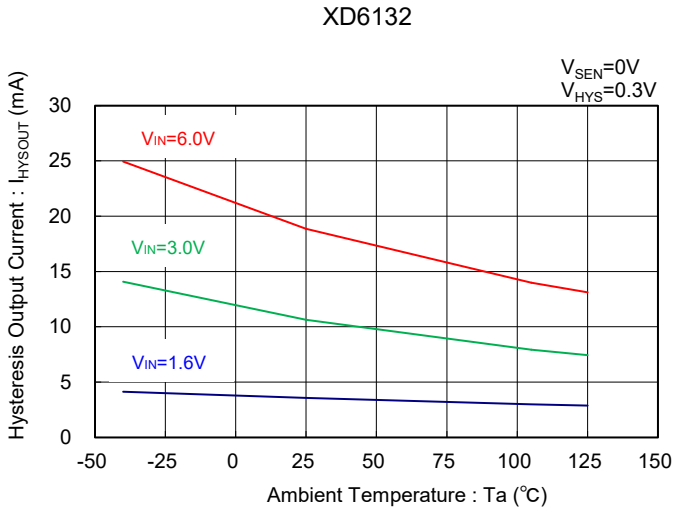
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Delay Time vs Ambient Temperature

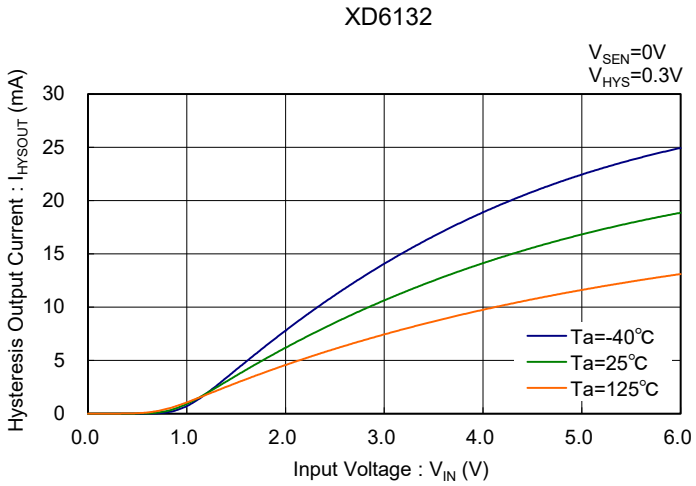




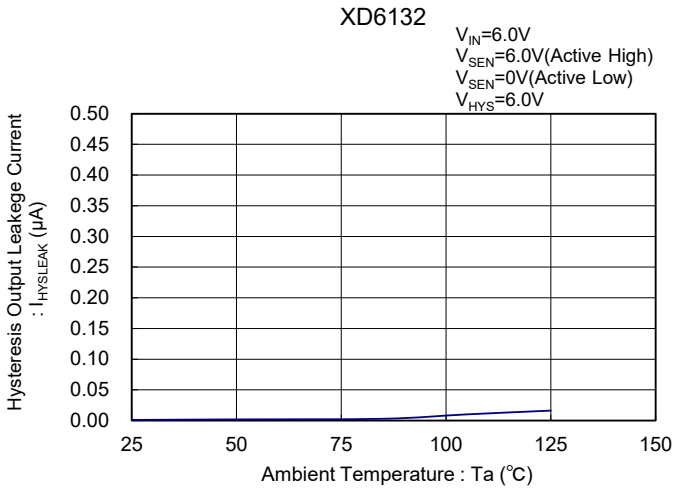
(8) Hysteresis Output Current vs Ambient Temperature



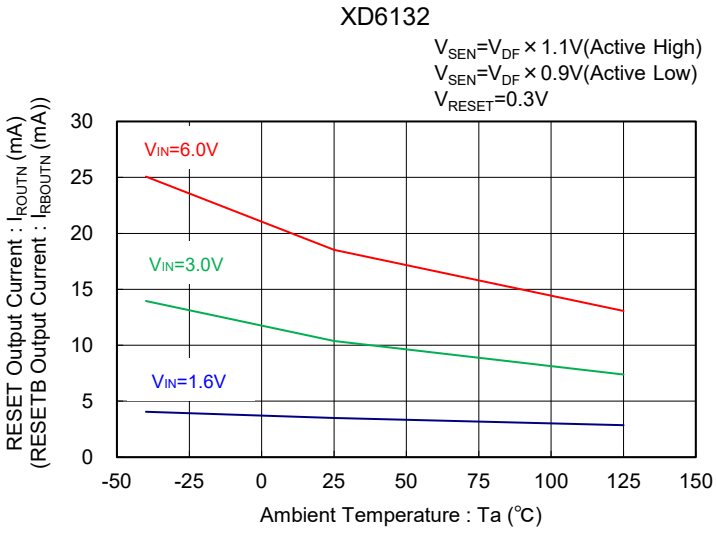
(9) Hysteresis Output Current vs Input Voltage



(10) Hysteresis Output Leakage Current vs Ambient Temperature

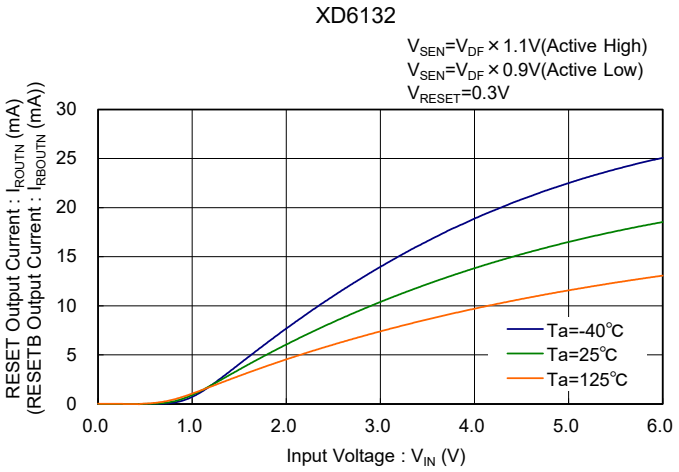


(11) RESET(RESETB) Output Current vs Ambient Temperature

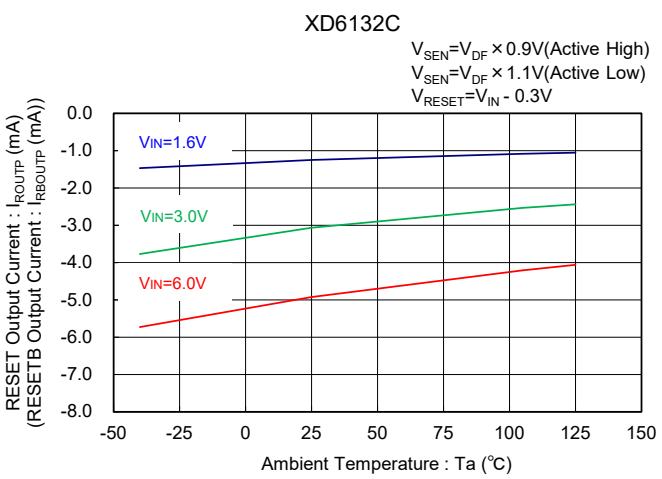


■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

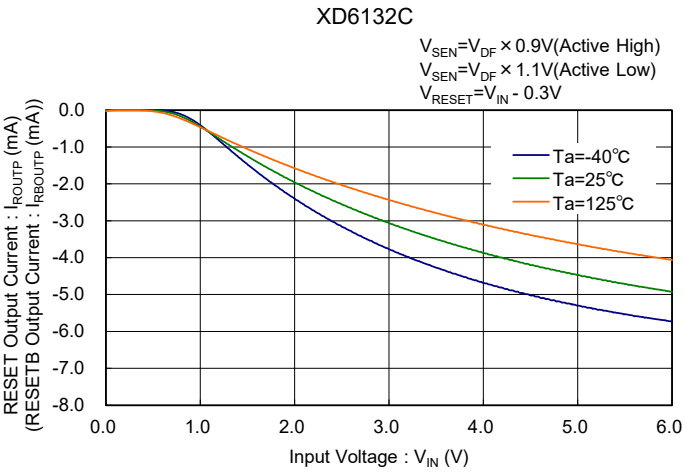
(12) RESET(RESETB) Output Current vs Input Voltage



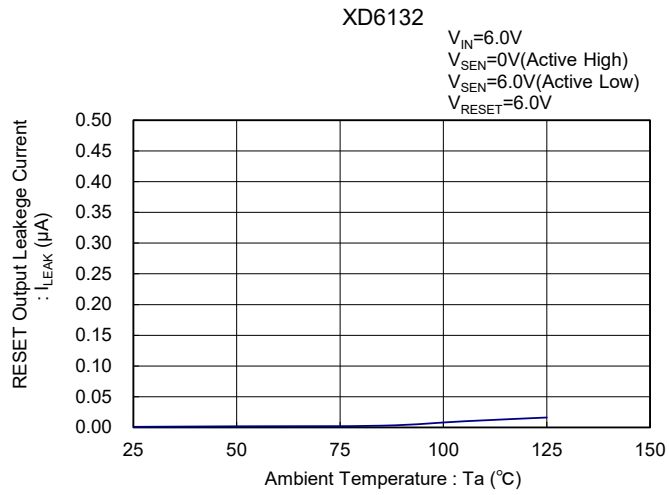
(13) RESET(RESETB) Output Current vs Ambient Temperature



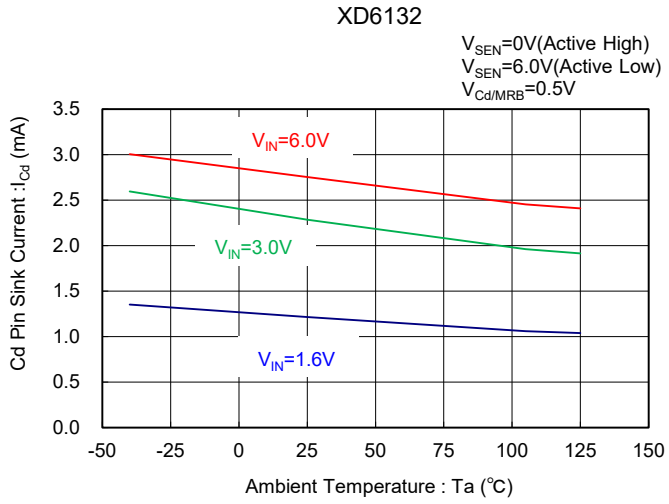
(14) RESET(RESETB) Output Current vs Input Voltage



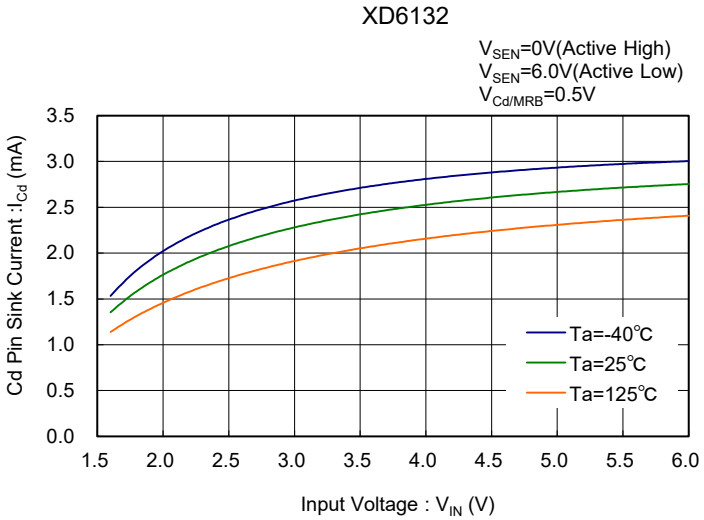
(15) RESET Output Leakage Current vs Ambient Temperature



(16) Cd Pin Sink Current vs Ambient Temperature



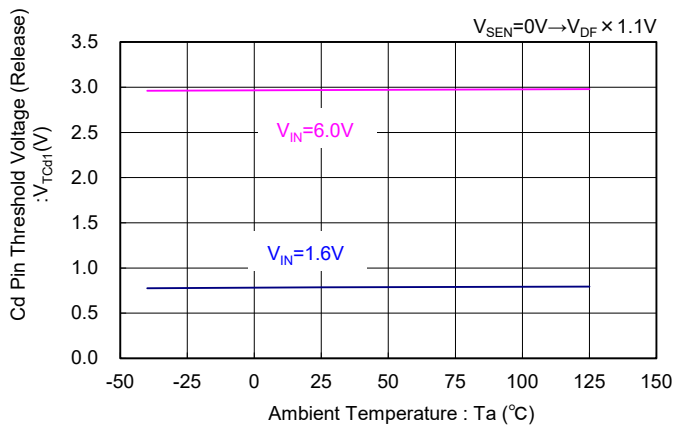
(17) Cd Pin Sink Current vs Input Voltage



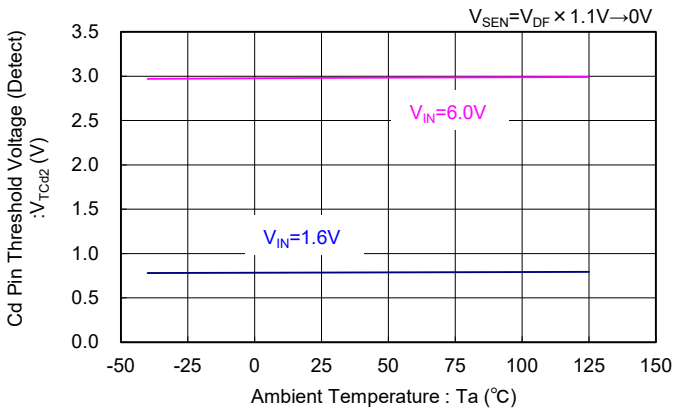
■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(18) Cd Pin Threshold Voltage vs Ambient Temperature

XD6132

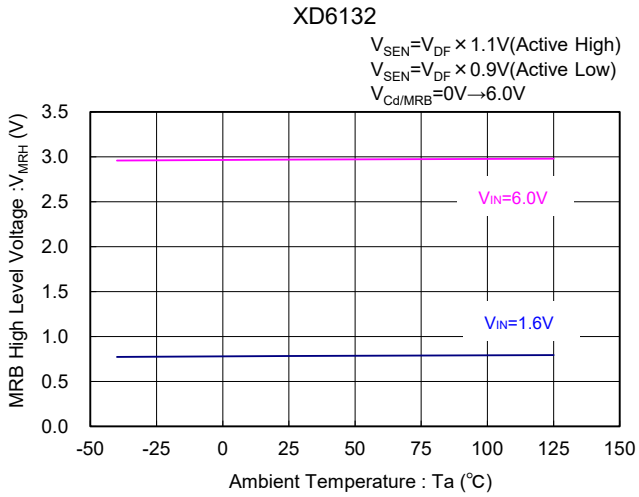


XD6132



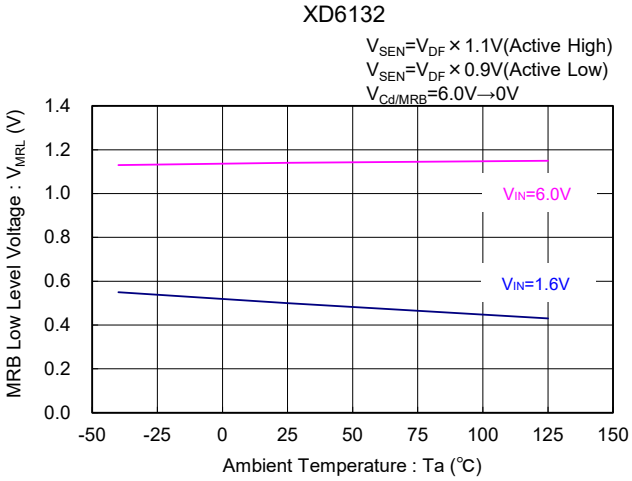
(19) MRB High Level Voltage vs Ambient Temperature

XD6132



(20) MRB Low Level Voltage vs Ambient Temperature

XD6132



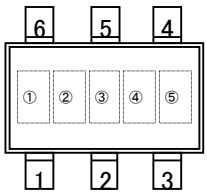
■PACKAGING INFORMATION

For the latest package information go to, www.torexsemi.com/technical-support/packages

PACKAGE	OUTLINE / LAND PATTERN	THERMAL CHARACTERISTICS
SOT-26	SOT-26 PKG	SOT-26 Power Dissipation
USP-6C	USP-6C PKG	USP-6C Power Dissipation

■MARKING RULE

SOT-26

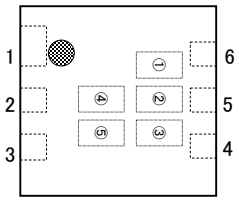


① represents products series

MARK	PRODUCT SERIES
3	XD6132******-Q

②,③ represents internal sequential number
01, ⋯,09, 10, ⋯, 99, A0, ⋯, A9, B0, ⋯, B9, ⋯, Z9⋯ repeated.
(G, I, J, O, Q, W excluded)

USP-6C



④,⑤ represents production lot number
01~09, 0A~0Z, 11~9Z, A1~A9, AA~AZ, B1~ZZ in order.
(G, I, J, O, Q, W excluded)
* No character inversion used.

*Represent product name (full product number) based on mark ①.

1. The product and product specifications contained herein are subject to change without notice to improve performance characteristics. Consult us, or our representatives before use, to confirm that the information in this datasheet is up to date.

2. The information in this datasheet is intended to illustrate the operation and characteristics of our products. We neither make warranties or representations with respect to the accuracy or completeness of the information contained in this datasheet nor grant any license to any intellectual property rights of ours or any third party concerning with the information in this datasheet.

3. Applicable export control laws and regulations should be complied and the procedures required by such laws and regulations should also be followed, when the product or any information contained in this datasheet is exported.

4. The product is neither intended nor warranted for use in equipment of systems which require extremely high levels of quality and/or reliability and/or a malfunction or failure which may cause loss of human life, bodily injury, serious property damage including but not limited to devices or equipment used in 1) nuclear facilities, 2) aerospace industry, 3) medical facilities, 4) automobile industry and other transportation industry and 5) safety devices and safety equipment to control combustions and explosions, excluding when specified for in-vehicle use or other uses.
   Do not use the product for in-vehicle use or other uses unless agreed by us in writing in advance.

5. Although we make continuous efforts to improve the quality and reliability of our products; nevertheless Semiconductors are likely to fail with a certain probability. So in order to prevent personal injury and/or property damage resulting from such failure, customers are required to incorporate adequate safety measures in their designs, such as system fail safes, redundancy and fire prevention features.

6. Our products are not designed to be Radiation-resistant.

7. Please use the product listed in this datasheet within the specified ranges.

8. We assume no responsibility for damage or loss due to abnormal use.

9.

TOREX SEMICONDUCTOR LTD.