DESCRIPTION

The AG2136 is a high voltage, high speed power MOSFET and IGBT drivers with a three independent high and low side referenced output channels for 3-phase applications. The floating channels can be used to drive N-channel power MOSFETs or IGBTs in the high side configuration which operates up to 600V. Logic inputs are compatible with CMOS or LSTTL outputs, down to 3.3V logic. A current trip function which terminates all six outputs can be derived from an external current sense resistor.

An enable function is available to terminate all six outputs simultaneously. An open-drain FAULT signal is provided to indicate that an over-current or under-voltage shutdown has occurred. Over-current fault conditions are cleared automatically after a delay programmed externally via an RC network connected to the RCIN input. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use in high frequency applications.

AG2136 is available in a SOP28 package.

FEATURES

- Fully operational to +600 V
- 3.3 V logic compatible
- dV/dt Immunity ±50 V/nsec
- Floating channel designed for bootstrap operation
- Gate drive supply range from 10 V to 20 V
- UVLO for all channels
- Cross-conduction prevention logic
- Over-current shutdown turns off all six drivers
- Externally programmable delay for automatic fault clear
- Independent 3 half-bridge drivers
- - 7V negative Vs ability
- Matched propagation delay for all channels
- Available in a SOP28 package.

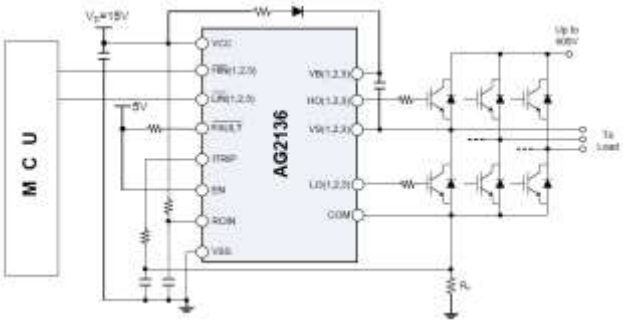
APPLICATION

- Motor Control
- Air Conditioners/ Washing Machines
- General Purpose Inverters
- Micro/Mini Inverter Drives

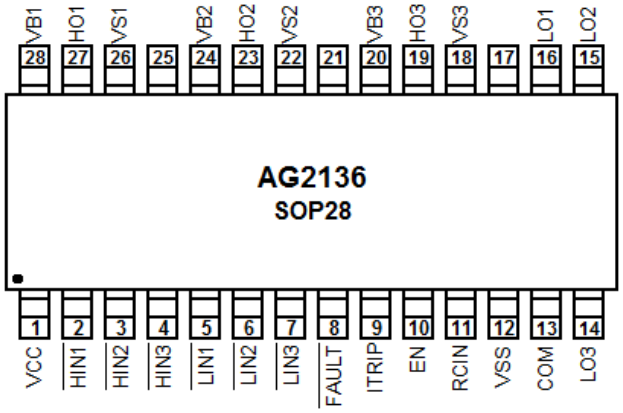
ORDERING INFORMATION

Package Type	Part Number	
SOP28 (wide body) SPQ: 1,000pcs/Reel	M28	AG2136M28R
		AG2136M28VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

TYPICAL APPLICATION CIRCUIT



PIN DESCRIPTION



Top View

Pin #	Symbol	Function
1	V_{CC}	Low side and logic fixed supply voltage
2	$\overline{HIN1}$	Signal Input for 1 Phase High-side
3	$\overline{HIN2}$	Signal Input for 2 Phase High-side
4	$\overline{HIN3}$	Signal Input for 3 Phase High-side
5	$\overline{LIN1}$	Signal Input for 1 Phase Low-side
6	$\overline{LIN2}$	Signal Input for 2 Phase Low-side
7	$\overline{LIN3}$	Signal Input for 3 Phase Low-side
8	$\overline{FAULT}$	Indicates over-current (ITRIP)or low-side under-voltage lockout
9	ITRIP	Analog input for overcurrent shutdown.
10	EN	Logic input to enable I/O functionality
11	RCIN	External RC network input used to define FAULT CLEAR delay
12	V_{SS}	Logic ground
13	COM	Low side gate drivers return
14	LO3	Low side gate driver outputs for 3 Phase
15	LO2	Low side gate driver outputs for 2 Phase
16	LO1	Low side gate driver outputs for 1 Phase
18	VS3	High voltage floating supply return for 3 Phase
19	HO3	High side gate driver outputs for 3 Phase
20	VB3	High side floating supply for 3 Phase
22	VS2	High voltage floating supply return for 2 Phase
23	HO2	High side gate driver outputs for 2 Phase
24	VB2	High side floating supply for 2 Phase
26	VS1	High voltage floating supply return for 1 Phase
27	HO1	High side gate driver outputs for 1 Phase
28	VB1	High side floating supply for 1 Phase

ABSOLUTE MAXIMUM RATINGS

Exceeding these ratings may damage the device.
The absolute maximum ratings are stress ratings only at T_A=25°C, unless otherwise specified.

$V_{B1,2,3}$, High Side Floating Supply		-0.3V ~ 620V
$V_{S1,2,3}$, High Side Floating Supply Return		V_B -20V ~ V_B +0.3V
$V_{HO1,2,3}$, High Side Gate Drive Output		V_S -0.3V ~ V_B +0.3V
V_{CC}, Low Side and Main Power Supply		-0.3V ~ 20V
$V_{LO1,2,3}$, Low Side Gate Drive Output		COM-0.3V ~ V_{CC} +0.3V
V_{IN}, Logic Input of $\overline{HIN}$ & $\overline{LIN}$		V_{SS} -0.3V ~ V_{CC} +0.3V
V_{SS}, Logic Ground		V_{CC} -20V~ V_{CC} +0.3V
V_{RCIN}, RCIN input voltage		V_{SS} ~ V_{CC}
V_{FLT}, $\overline{AFULT}$ Output Voltage		V_{SS} -0.3V ~ V_{CC} +0.3V
dV_S/dt, Allowable Offset Supply Voltage Transient		50V/ns
ESD, HBM Model		2.5kV
ESD, Machine Model		200V
P_D, Package Power Dissipation @ T_A ≤25°C	SOP28	1.6W
Rth_{JA}, Thermal Resistance Junction to Ambient	SOP28	78℃/W
T_J, Junction Temperature		150℃
T_S, Storage Temperature		-55℃~150℃
T_L, Lead Temperature (Soldering, 10 seconds)		300℃

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Max.	Units
High Side Floating Supply	$V_{B1,2,3}$	V_S +10	V_S +20	V
High Side Floating Supply Return	$V_{S1,2,3}$	COM-7	600	
High Side Gate Drive Output Voltage	$V_{HO1,2,3}$	$V_{S1,2,3}$	$V_{B1,2,3}$	
Low Side Supply	V_{CC}	10	20	
Low Side Gate Drive Output Voltage	$V_{LO1,2,3}$	0	V_{CC}	
Logic Input Voltage($\overline{HIN}$ & $\overline{LIN}$)	V_{IN}	0	V_{CC}	
Logic Ground	V_{SS}	-5	5	
RCIN Input Voltage	V_{RCIN}	V_{SS}	V_{CC}	
$\overline{FAULT}$ Output Voltage	V_{FLT}	V_{SS}	V_{CC}	
Ambient Temperature	T_A	-40	125	℃

DYNAMIC ELECTRICAL CHARACTERISTICS

V_{BIAS} (V_{CC}, V_{BS}) = 15V, C_L = 1000pF and T_A = 25°C, unless otherwise specified.

Parameter	Symbol	Min	Typ.	Max	Units
Turn-On Propagation Delay	t_{on}	400	530	750	ns
Turn-Off Propagation Delay	t_{off}	400	530	750	
Turn-On Rising Time	t_r	-	125	190	
Turn-Off Fall Time	t_f	-	50	75	
Input Filter Time ($\overline{HIN}$ & $\overline{LIN}$)	$t_{IN,FLT}$	200	350	510	
Enable Low To Output Shutdown Propagation Delay	t_{EN}	350	460	650	
Enable Input Filter Time	$t_{EN,FLT}$	100	200	-	
UVCC Filter Time	t_{UVCC}	-	7	-	us
UVBS Filter Time	t_{UVBS}	-	7	-	
UVCC to FAULT Shutdown Propagation Delay	$t_{UVCC,FO}$	-	7	-	
UVCC to LO Shutdown Propagation Delay	$t_{UVCC,LO}$	-	7	-	
UVBS to HO Shutdown Propagation Delay	$t_{UVBS,HO}$	-	7	-	
$\overline{FAULT}$ Output Duration Time (RCIN: C = 1nF, R = 2 MΩ)	t_{FOd}	1.3	1.65	2	ms
ITRIP to Output Shutdown Propagation Delay	t_{ITRIP}	420	620	970	ns
ITRIP Filter Time	$t_{IT,FLT}$	-	400	-	
ITRIP to $\overline{FAULT}$ Propagation Delay	t_{FO}	400	600	950	
Deadtime	DT	190	275	420	
DT Matching	MDT	-	-	60	
Delay Matching Time (t_{ON}, t_{OFF})	MT	-	-	50	
Pulse Width Distortion[NOTE1]	PM	-	-	75	

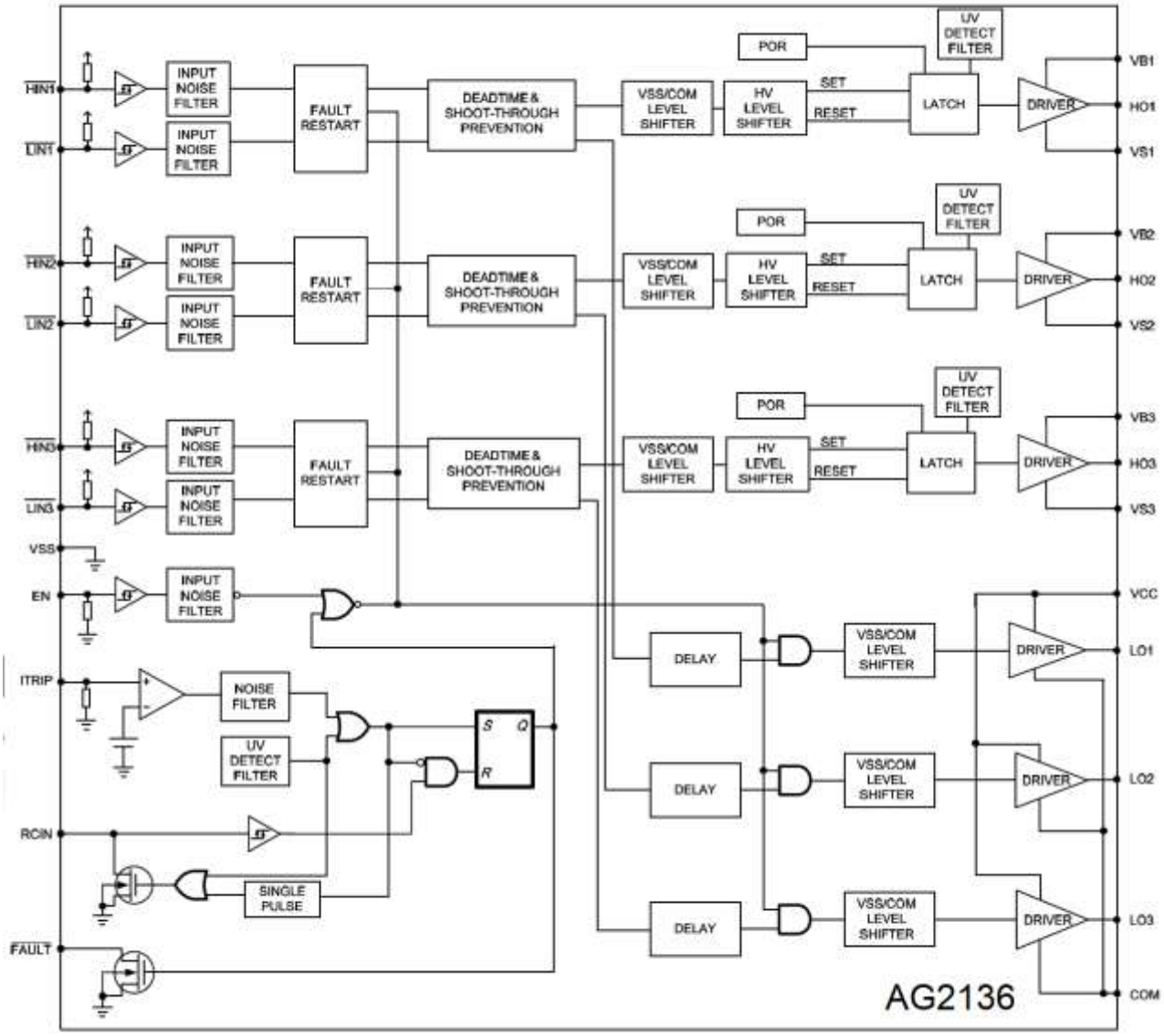
NOTE1: PM is defined as PW_{IN}-PW_{OUT}

STATIC ELECTRICAL CHARACTERISTICS

V_{BIAS} (V_{CC}, V_{BS}) = 15V, C_L = 1000 pF and T_A = 25°C unless otherwise specified.

Parameter	Symbol	Min	Typ.	Max	Units
V_{CC} Supply Under Voltage Positive Going Threshold	V_{UVCC+}	8	8.9	9.8	V
V_{CC} Supply Under Voltage Negative Going Threshold	V_{UVCC-}	7.4	8.2	9.0	
V_{CC} Supply Under Voltage Hysteresis	V_{UVCCHY}	0.3	0.7	-	
High-Side Floating Supply Leakage Current	I_{LK}	-	-	50	µA
Quiescent V_{BS} Supply Current	I_{QBS}	-	70	120	
Quiescent V_{CC} Supply Current	I_{QCC}	-	1	2	mA
Operating V_{BS} Supply Current	I_{PBS}	-	400	600	µA
Operating V_{CC} Supply Current (per 1phase)	I_{PCC}	-	1.3	1.8	mA
High Level Output Voltage Drop, V_{BIAS} - V_O	V_{OH}	-	0.9	1.4	V
Low Level Output Voltage Drop, V_O	V_{OL}	-	0.4	0.6	
Output High Short Circuit Pulsed Current	I_{O+}	120	200	-	mA
Output Low Short Circuit Pulsed Current	I_{O-}	250	350	-	
High Level Input Threshold Voltage	V_{IH}	2.5	-	-	V
Low Level Input Threshold Voltage	V_{IL}	-	-	0.8	
Input Clamp Voltage($\overline{HIN}$, $\overline{LIN}$, ITRIP, EN)	V_{CLAMP}	5.2	5.6	5.9	
Input Bias Current (HO = High)	I_{HIN+}	-	150	200	µA
Input Bias Current (HO = Low)	I_{HIN-}	-	110	150	
Input Bias Current (LO = High)	I_{LIN+}	-	150	200	
Input Bias Current (LO = Low)	I_{LIN-}	-	110	150	
RCIN Positive Going Threshold	$V_{RCIN,TH}$	-	8	-	V
RCIN Hysteresis	$V_{RCIN,HY}$	-	3	-	
RCIN Input Bias Current	I_{RCIN}	-	-	1	µA
RCIN Low On Resistance	$R_{RCIN,ON}$	-	50	100	Ω
ITRIP Positive Going Threshold	$V_{IT,TH+}$	0.42	0.46	0.5	V
ITRIP Negative Going Threshold	$V_{IT,TH-}$	-	0.4	0.49	
ITRIP Hysteresis	$V_{IT,HY}$	-	0.06	-	
“High” ITRIP Input Bias Current	I_{ITRIP+}	-	5	40	µA
“Low” ITRIP Input Bias Current	I_{ITRIP-}	-	-	1	
Enable Positive Going Threshold	$V_{EN,TH+}$	-	-	2.5	V
Enable Negative Going Threshold	$V_{EN,TH-}$	0.8	-	-	
“High” Enable Input Bias Current	I_{EN+}	-	5	40	µA
“Low” Enable Input Bias Current	I_{EN-}	-	-	1	
$\overline{FAULT}$ Low On Resistance	$R_{FO,ON}$	-	50	100	Ω

BLOCK DIAGRAM



FUNCTION TIMING DIAGRAM

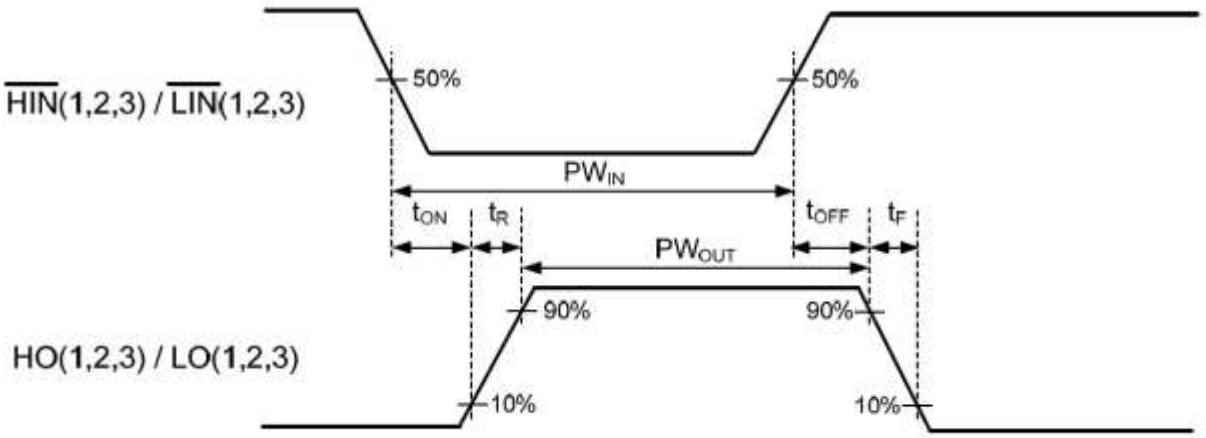


Fig.1 Switching timing waveform

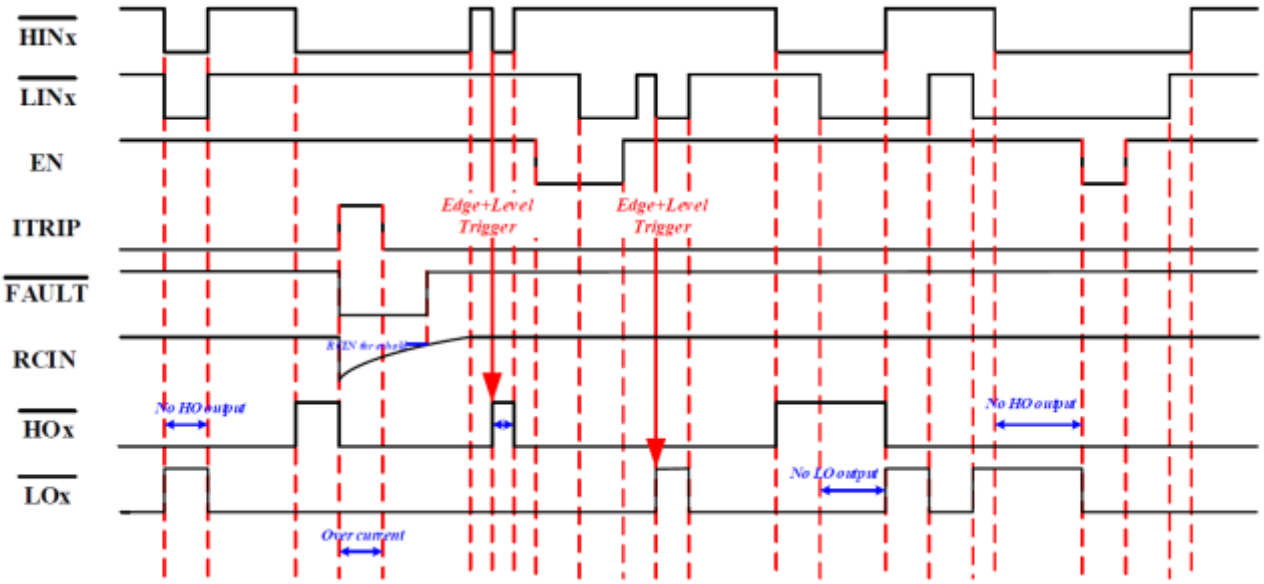


Fig.2 Input/Output timing waveform

PARAMETER TEMPERATURE TRENDS

Figures 3-24 provide information on the experimental performance of the AG2136 HVIC. The line plotted in each figure is generated from actual lab data. A small number of individual samples were tested at three temperatures (-40℃, 25℃, and 125℃) in order to generate the experimental (Exp.) curve. The line labeled Exp. consist of three data points (one data point at each of the tested temperatures) that have been connected together to illustrate the understood temperature trend. The individual data points on the curve were determined by calculating the averaged experimental value of the parameter (for a given temperature).

Figure 3. t_{ON} vs. temperature

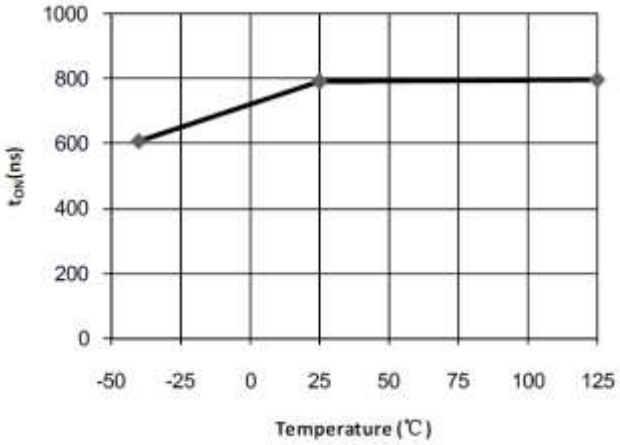


Figure 4. t_{OFF} vs. temperature

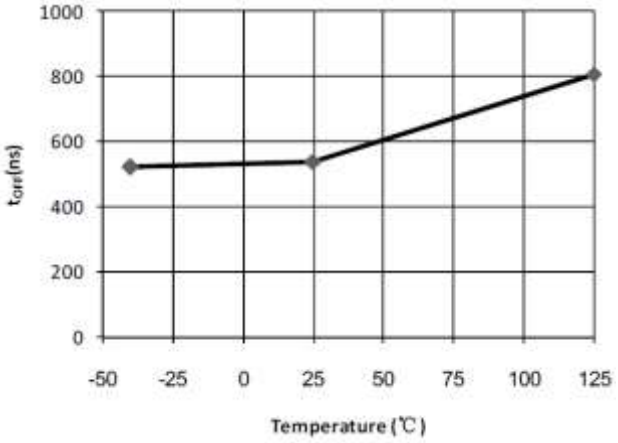


Figure 5. DT vs. temperature

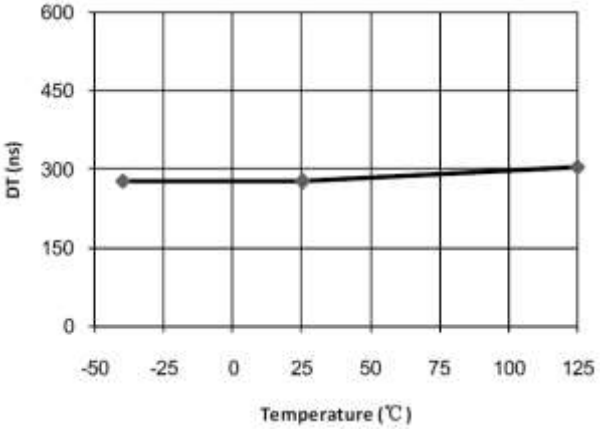


Figure 6. t_{ITRIP} vs. temperature

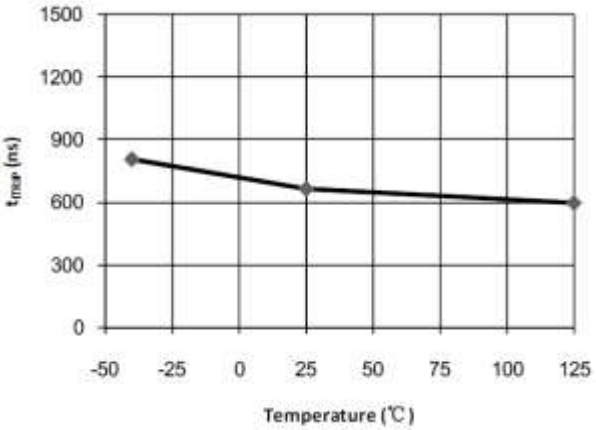


Figure 7. t_{FLT} vs. temperature

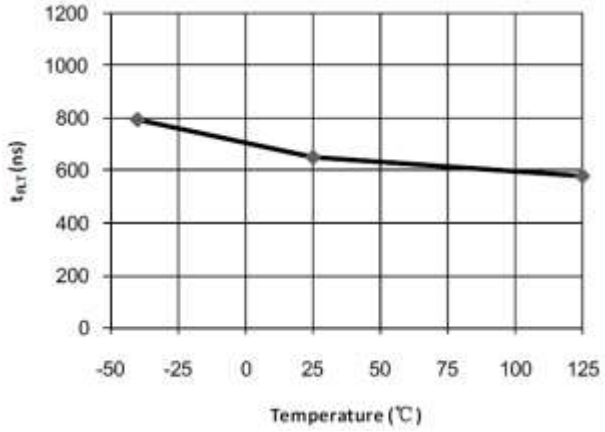


Figure 8. t_{EN} vs. temperature

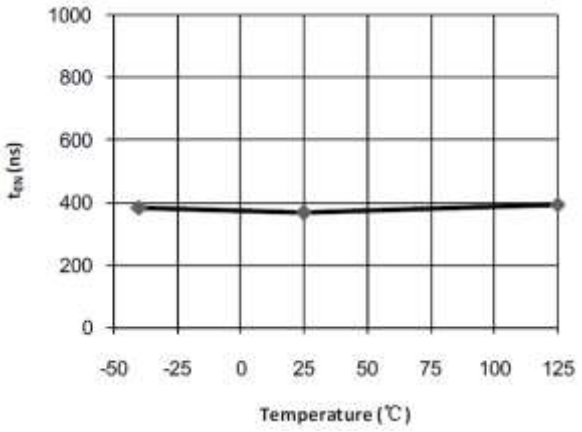


Figure 9. MT vs. temperature

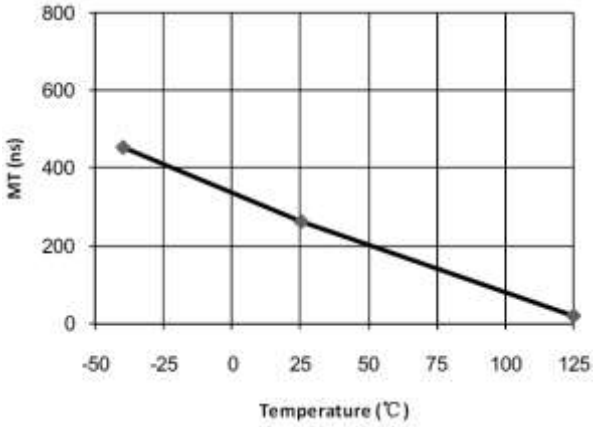


Figure 10. MDT vs. temperature

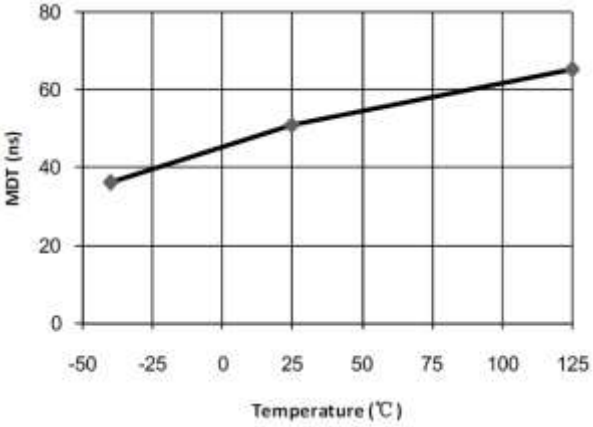


Figure 11. PM vs. temperature

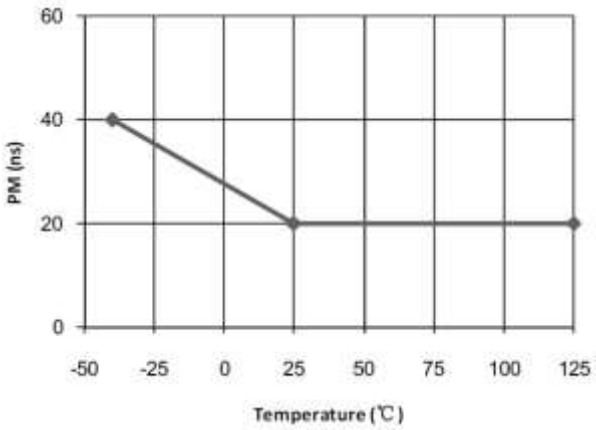


Figure 12. I_{ITRIP+} vs. temperature

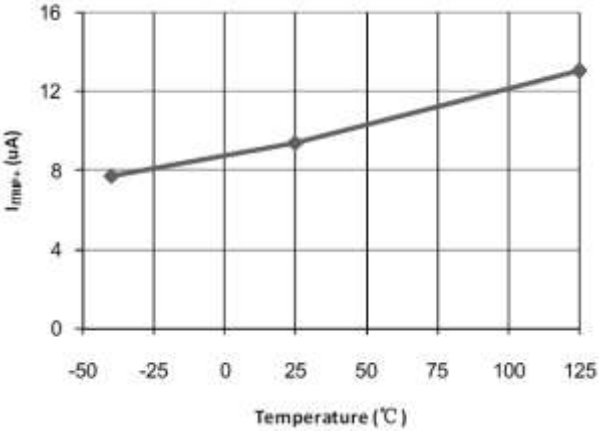


Figure 13. I_{QCC} vs. temperature

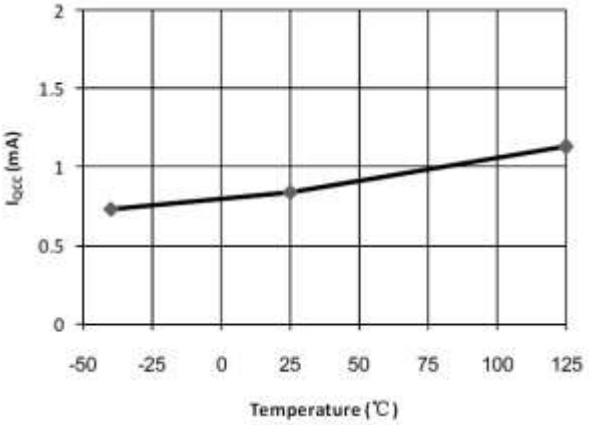


Figure 14. I_{QBS} vs. temperature

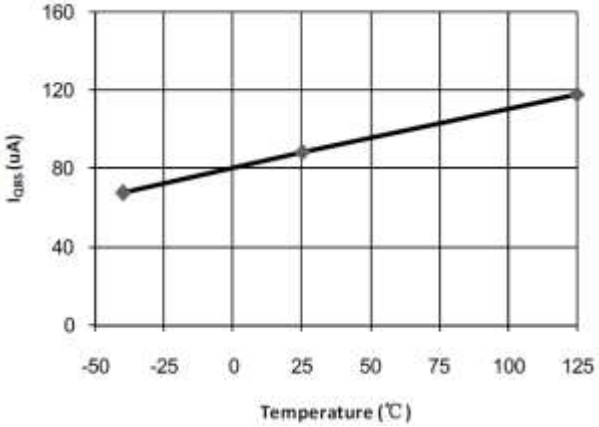


Figure 15. IO+ vs. temperature

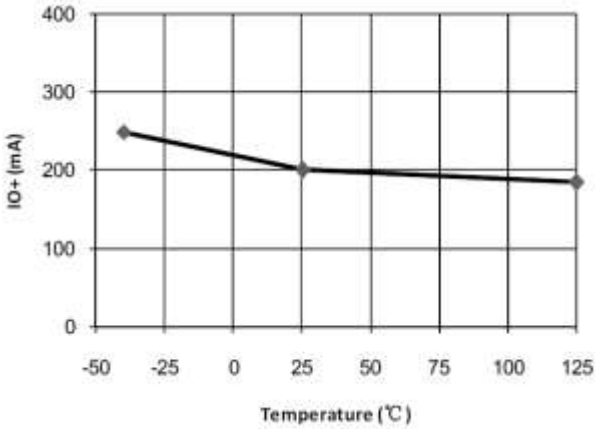


Figure 16. IO- vs. temperature

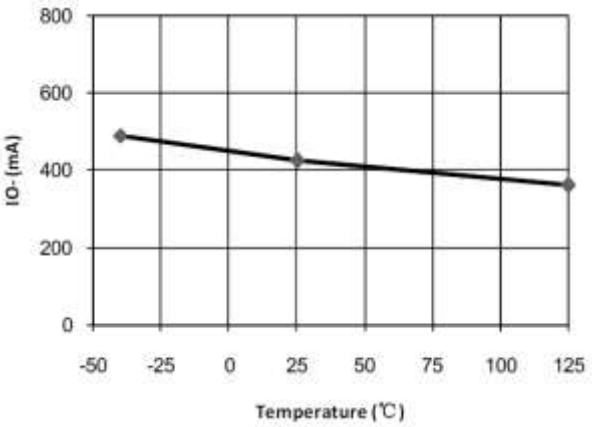


Figure 17. V_{CCUV+} vs. temperature

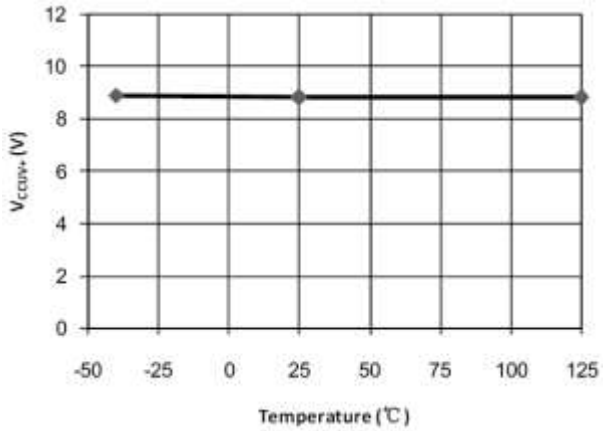


Figure 18. V_{CCUV-} vs. temperature

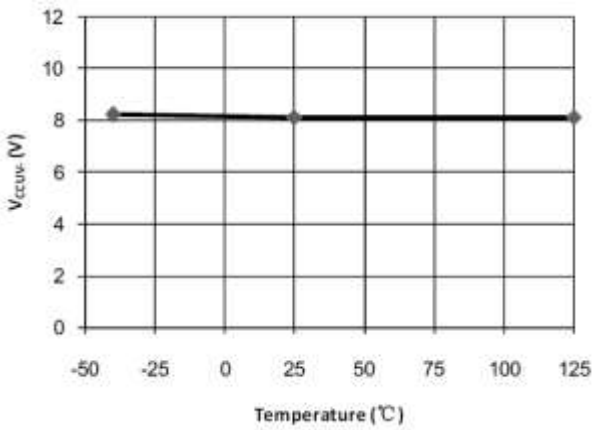


Figure 19. V_{BSUV+} vs. temperature

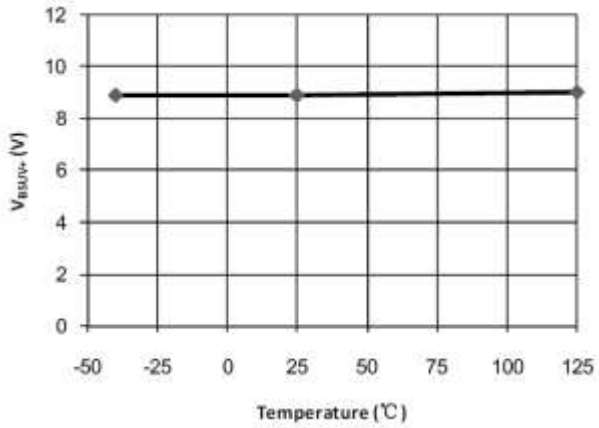


Figure 20. V_{BSUV-} vs. temperature

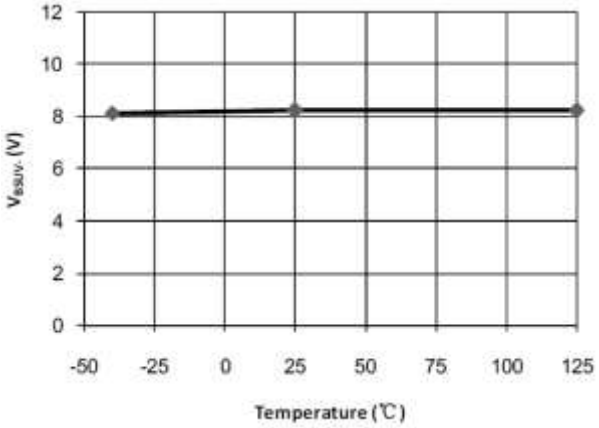


Figure 21. $V_{IT,TH+}$ vs. temperature

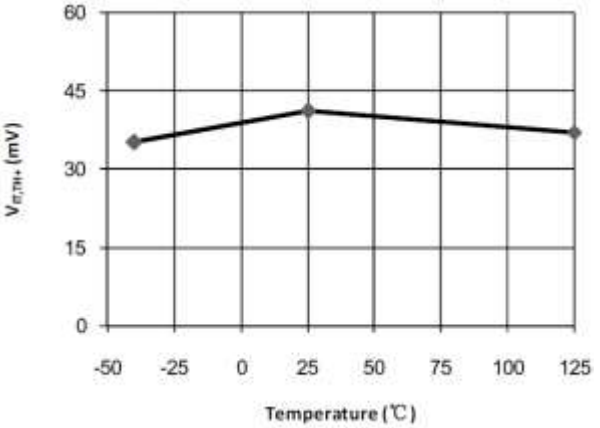


Figure 22. $V_{IT,TH-}$ vs. temperature

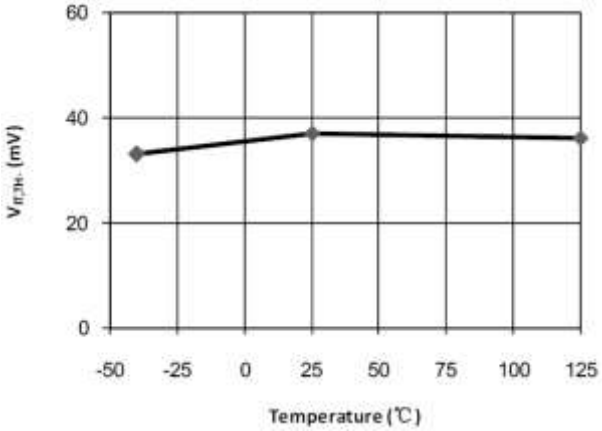


Figure 23. $R_{ON,RCIN}$ vs. temperature

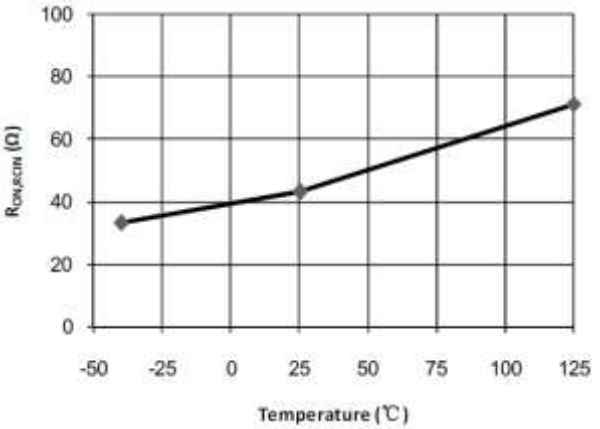
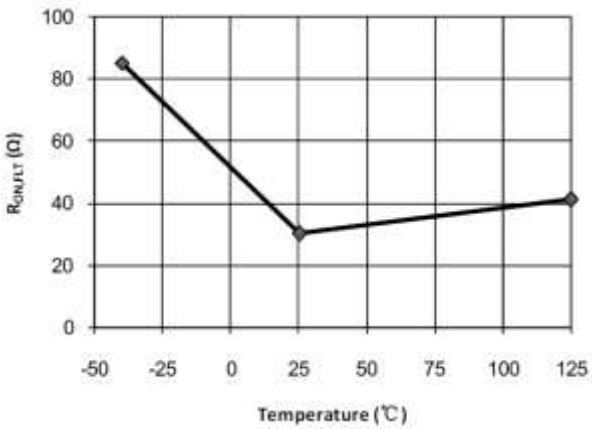
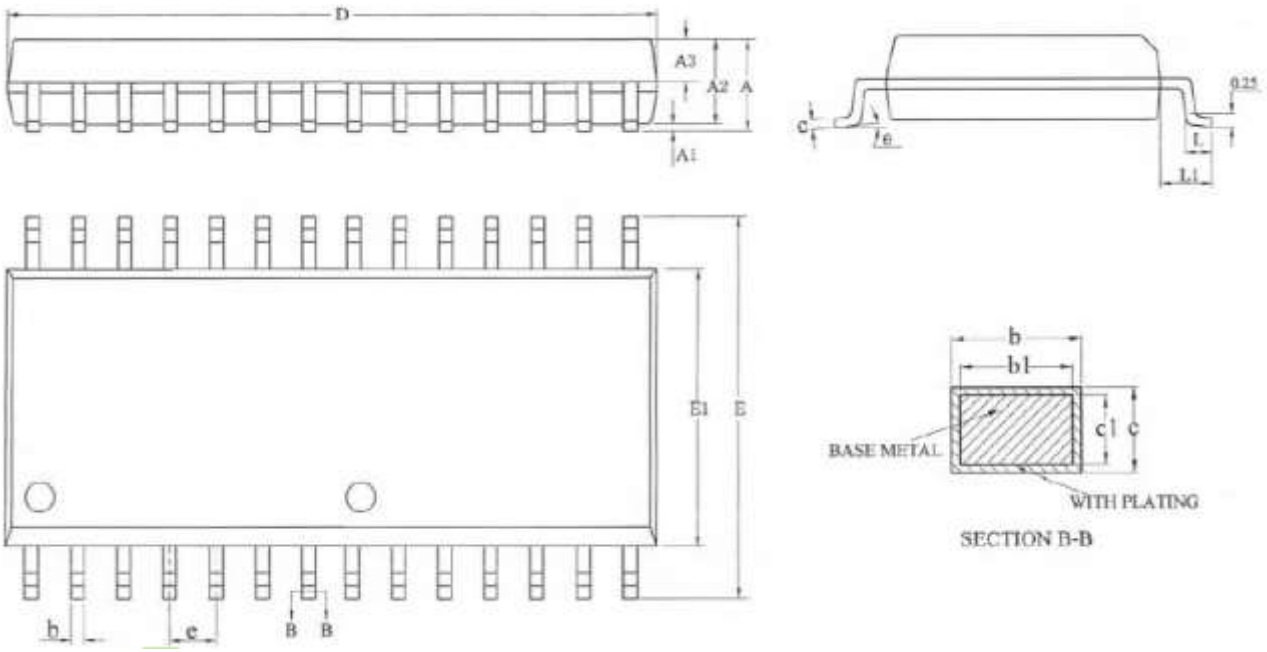


Figure 24. $R_{ON,FLT}$ vs. temperature



PACKAGE INFORMATION

Dimension in SOP28 (Unit: mm)



Symbol	Min.	Max.
A	-	2.65
A1	0.10	0.30
A2	2.25	2.35
A3	0.97	1.07
b	0.39	0.48
b1	0.38	0.43
c	0.25	0.31
c1	0.24	0.26
D	17.89	18.29
E	10.10	10.50
E1	7.30	7.70
e	1.27 BSC	
L	0.70	1.00
L1	1.40 BSC	
θ	0°	8°

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