MITSUMI

The synchronous rectification control IC forFlyback converter

MM3878 Series

概要

MM3878 is secondary side synchronous rectification control IC to drive the MOSFET in the Flyback converter. It is able to achieve very high efficiency by replacing secondary rectifier diode with MOSFET and MM3878. It is possible to correspond to various efficiency restrictions. And it is effective for the miniaturization of the power supply by the heat sink reduction and so on.

By providing the power from the drain terminal, you can operate the synchronous rectification on the high side (output terminal side) without the need for additional auxiliary windings on the secondary side.

The turn-on/off status of the synchronous rectifier MOSFET is controlled based on the drain-source voltages of itself. The turn-off timings are automatically optimized inside the MM3878 to enhance the effectiveness of synchronous rectification. The Package is SOT-26E.

Features

- Supports DCM Mode and CCM Mode
- Directly input VD signal
- Power supply from Drain (KVD Supply Function)
- Automatic turn off timing
- Automatic minimum on time setting

Function

- Operating Voltage of VD Pin : 180V (Absolute Maximum Voltage 200V)
- Operating Voltage of VCC pin : 4.75V to 34V (Not use KVD Supply Function)
- Operating Voltage of VCC pin : 3V to 8V (Use KVD Supply Function)
- IC Supply Current : Typ. 0.7mA (VCC=15V)
- Supports Frequency : ～ 300kHz

Package

- SOT-26E

Application

- AC-DC adapter
- USB-PD adapter
- Printer
- General prurpose power supply

Mitsumi Electric CO.,LTD.
Semiconductor Business Division
Strategy Engineering Department
tel:+81-46-230-3470

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Model Name

M M 3 8 7 8 x N R E

Series name (A) (B) (C) (D)

(A) 機能形式 / Function Type

機能名 / Function	機能形式 / Function Type				
	A	B	C	D	Unit
動作開始REG電圧 Turn On REG Voltage	5.45	-	-	-	V
動作停止REG電圧 Turn Off REG Voltage	5.35	-	-	-	V
動作開始VCC電圧 Turn On VCC Voltage	-	4.55	4.55	4.55	V
動作停止VCC電圧 Turn Off VCC Voltage	-	4.4	4.4	4.4	V
ターンオン禁止遅延時間 Turn On Prohibited Delay Time	350	350	575	730	ns
最小オン時間1 Minimum On Time 1	0.46	0.46	0.64	0.82	us
最小オン時間2 Minimum On Time 2	1.00	1.00	1.20	1.57	us
最小オン時間3 Minimum On Time 3	2.3	2.3	3.0	4.0	us

(B) パッケージ / Package

N	SOT-26E

(C) 梱包形態 / Type of packing

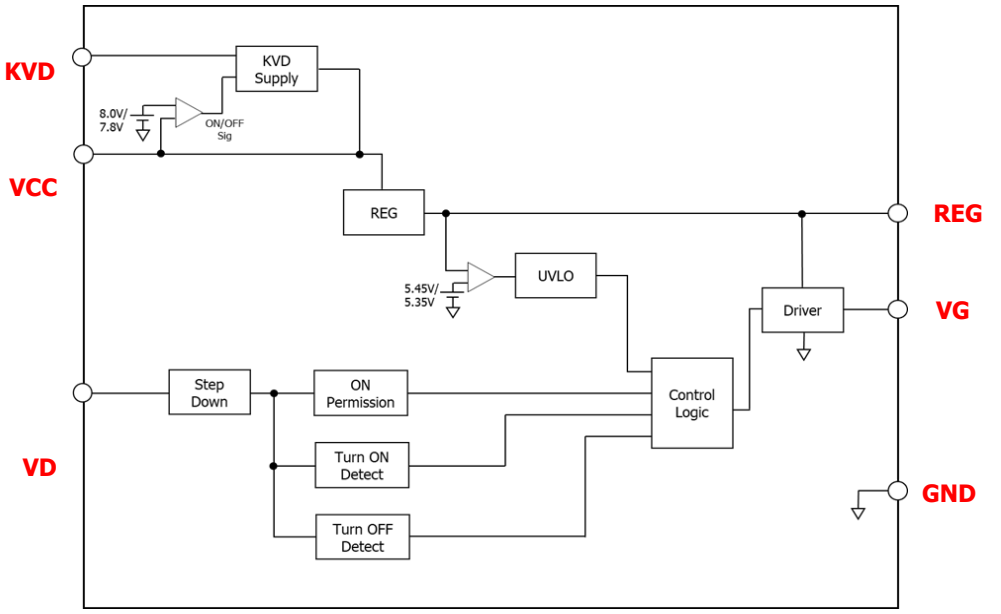
R	R収納 / R Housing

(D) テーピング材質 / Taping material

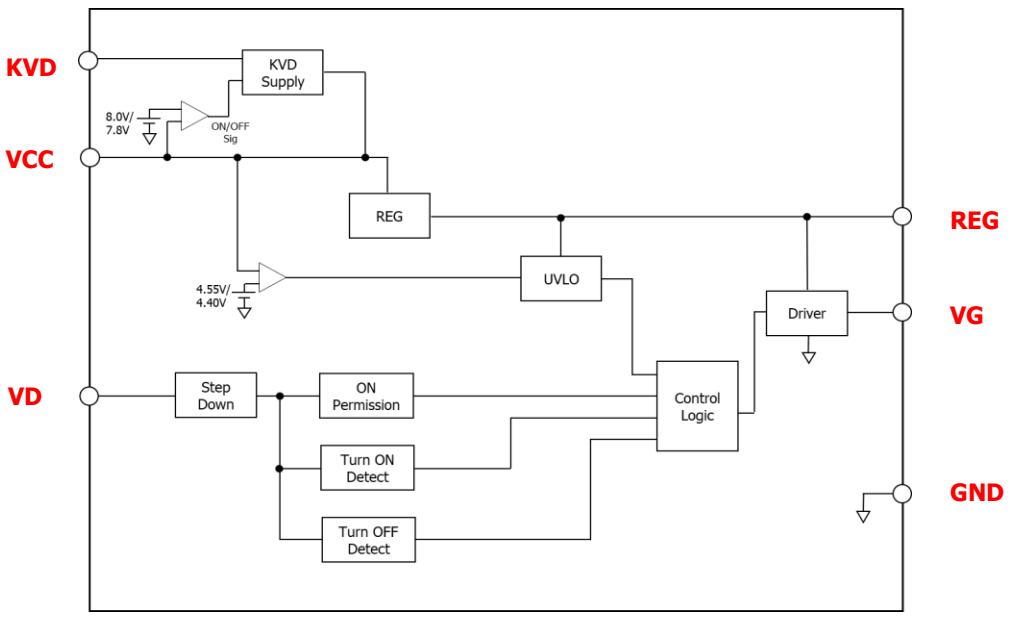
E	エンボステープ / Emboss tape

Block Diagram

A RANK

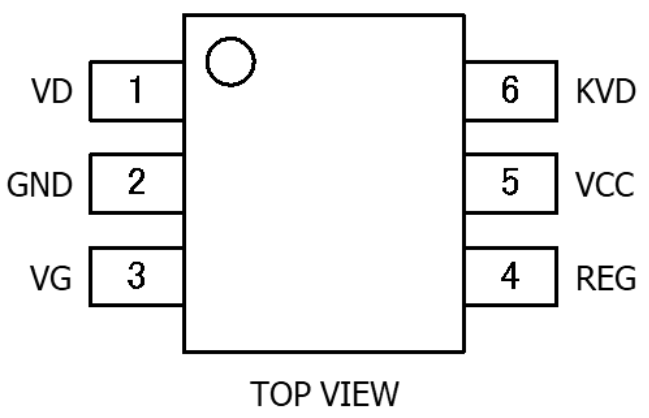


B, C, D RANK



Pin Configuration

■ SOT-26E



PIN No.	Symbol	Function
1	VD	MOSFET Drain Voltage Detection
2	GND	Ground
3	VG	Gate Driver Output
4	REG	Internal Regulation Output
5	VCC	IC Power Input
6	KVD	High voltage supply input

Absolute Maximum Ratings

(unless otherwise Ta=25℃)

Item	Symbol	Min	Max	Unit
VCC Input Voltage	V_{CCmax}	-0.3	38	V
VD Input Voltage (DC)	V_{Dmax}	-2	200	V
KVD Input Voltage(Not use KVD)	$V_{KVDmax1}$	-0.3	200	V
KVD Input Voltage(Use KVD)	$V_{KVDmax2}$	-0.3	85	V
REG Input Voltage	V_{REGmax}	-	8	V
Storage Temperature	T_{stg}	-50	150	℃
Ppwer Dissipation*1	Pd	-	490	mW
ESD (HBM)	V_{ESD_HBM}	-2	2	kV
ESD (CDM)	V_{ESD_CCM}	-500	500	V

Note

*1 Size: 15.0mm×15.0mm, Single Pattern, t:0.8mm, Cupper: 30%

Operating Conditions

Item	Symbol	Min	Max	Unit
Junction Temprature	T_j	-40	150	℃
VD Input Voltage (DC)	V_{DOPE}	11	180	V
KVD Input Voltage(Not use KVD)	$V_{KVDpeak1}$	11	180	V
KVD Input Voltage(Use KVD)	$V_{KVDpeak2}$	15	80	V
VCC Input Voltage (A Rank)	VCC_{ope}	8	34	V
VCC Input Voltage (B, C, D)	VCC_{ope}	4.75	34	V
VD Limiting Resisitance	R_{VD}	0	620	Ω
REG Output Voltage	V_{REGOPE}	-	7	V
REG Connected Capacitor	C_{REG}	1	10	uF

Electrical Characteristics

(Unless otherwise TA=25°C, VCC=15V)

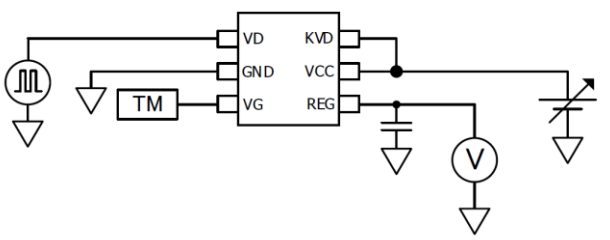
Item	Symbol	Condition	Min	Typ	Max	Unit	※1
Supply Section							
Turn On REG Voltage	V_{REG_START}	A RANK	5.2	5.45	5.7	V	A
Turn Off REG Voltage	V_{REG_START}	A RANK	5.1	5.35	5.6	V	A
Turn On VCC Voltage	V_{CC_START}	B, C, D RANK	4.35	4.55	4.75	V	A
Turn Off VCC Voltage	V_{REG_START}	B, C, D RANK	4.2	4.4	4.6	V	A
IC Supply Current	I_{VCC}	Cload =0pF, fsw=62.5kHz	-	0.7	-	mA	B
REG Output Voltage	V_{REG}	IREG=-5mA	6.5	6.8	-	V	C
KVD Supply Function							
KVD Input Current1	I_{KVD1}	KVD=20V, VCC=7V	8	-	-	mA	D
KVD Input Current2	I_{KVD2}	KVD=20V, VCC=7V	35	-	-	mA	D
KVD Stop Input Current	I_{KVDS}	KCD=180V	-	-	1	uA	E
KVD Supply Restart VCC Voltage	V_{KVDRE}	KCD=11V	7.3	7.8	8.3	V	F
KVD Supply Stop VCC Voltage	V_{KVDST}	KCD=11V	7.5	8	8.5	V	F
Drain Voltage Detecter Section							
Minimum VD Peak Pulse Width	T_{VDHmin}		350	450	550	ns	G
Turn On VD Thresh Voltage	V_{th_on}	A RANK	-400	-250	-100	mV	G
	V_{th_on}	B, C, D RANK	-350	-200	-50	mV	G
Turn On Prohibited Delay Voltage	t_{OPD}	A, B RANK	220	350	480	ns	G
	t_{OPD}	C RANK	370	575	780	ns	G
	t_{OPD}	D RANK	470	730	990	ns	G
Maxmum On Time 1	T_{onmax1}		1.25	-	1.75	us	G
Maxmum On Time 2	T_{onmax2}		7.25	-	7.75	us	G
Minimum On Time 1	T_{onmin1}	A, B RANK t_{VDH}=2us, t_{VDL}=2us	0.35	0.48	0.61	us	G
	T_{onmin1}	C RANK t_{VDH}=2us, t_{VDL}=2us	0.4	0.64	0.82	us	G
	T_{onmin1}	D RANK t_{VDH}=2us, t_{VDL}=2us	0.59	0.82	1.05	us	G
Minimum On Time 2	T_{onmin2}	A, B RANK t_{VDH}=4us, t_{VDL}=4us	0.75	1	1.25	us	G
	T_{onmin2}	C RANK t_{VDH}=4us, t_{VDL}=4us	0.9	1.2	1.5	us	G
	T_{onmin2}	D RANK t_{VDH}=4us, t_{VDL}=4us	1.18	1.57	1.96	us	G
Minimum On Time 3	T_{onmin3}	A, B RANK t_{VDH}=16us, t_{VDL}=16us	1.8	2.3	2.8	us	G
	T_{onmin3}	C RANK t_{VDH}=16us, t_{VDL}=16us	2.35	3.00	3.65	us	G
	T_{onmin3}	D RANK t_{VDH}=16us, t_{VDL}=16us	3.10	4.00	4.90	us	G
VD Input Current 1	I_{VD1}	A, C, D RANK, VD=10V	-	-	40	uA	H
	I_{VD1}	B RANK, VD=10V	-	-	50	uA	H
VD Input Current 2	I_{VD2}	A, C, D RANK, VD=150V	-	-	500	uA	H
	I_{VD2}	B RANK, VD=150V	-	-	650	uA	H
Gate Driver Output							
VG Output High Voltage	V_{GH}	IG=-5mA	6	-	-	V	G
VG Output Low Voltage	V_{GL}	IG=-25mA	-	-	0.1	V	G
VG Rise Time	T_r	KCD=180V	-	30	-	ns	G
VG Fall Time	T_f	KCD=11V	-	20	-	ns	G
Turn-On Propagation Delay	T_{DON}	KCD=11V	-	130	-	ns	I
Turn-Off Propagation Delay	T_{DOFF}	t_{VDH}=0.6us, t_{VDL}=3.4us	-	-	25	ns	I
Thermal Characteristics							
Thermal Resisitance	θ_{ja}	※2	-	195.3	-	℃/W	

注釈 *1 The symbol of Test Circuit

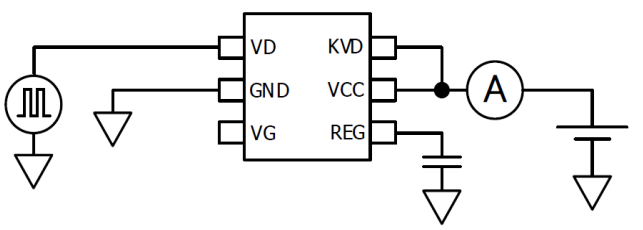
*2 Size:76.2mm×114.3mm, Double Pattern, t:1.6mm、Cupper: 20%

Test Circuit

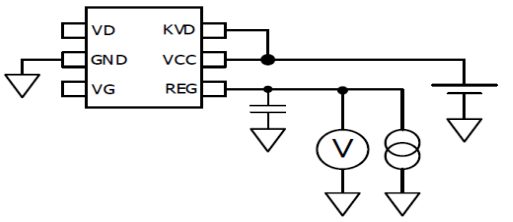
Test Circuit A



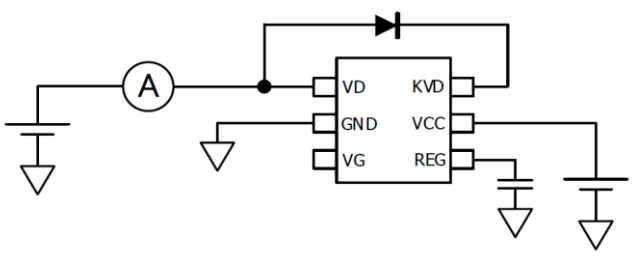
Test Circuit B



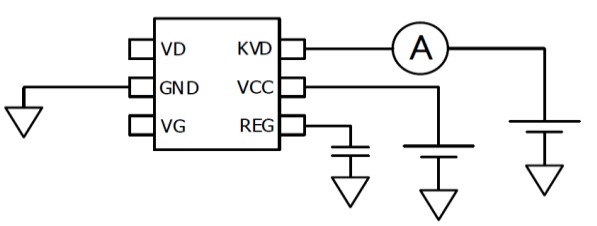
Test Circuit C



Test Circuit D

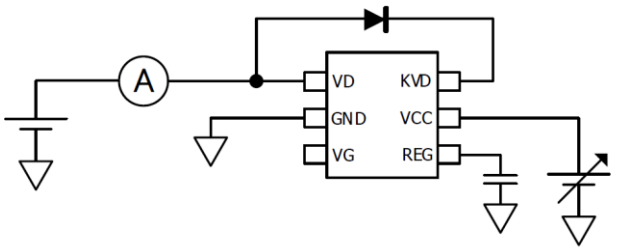


Test Circuit E

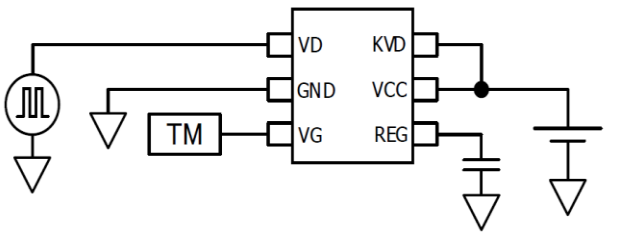


Test Circuit

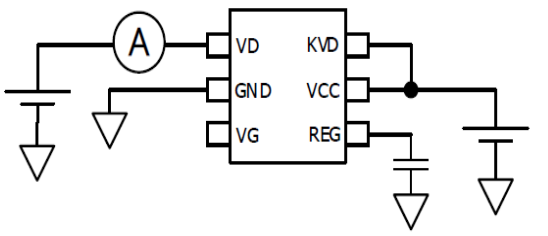
Test Circuit F



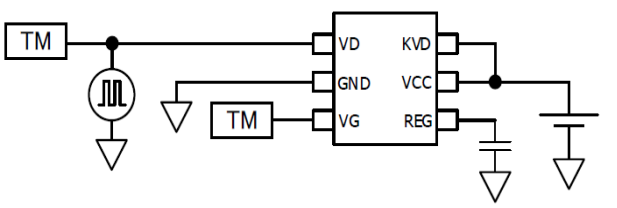
Test Circuit G



Test Circuit H



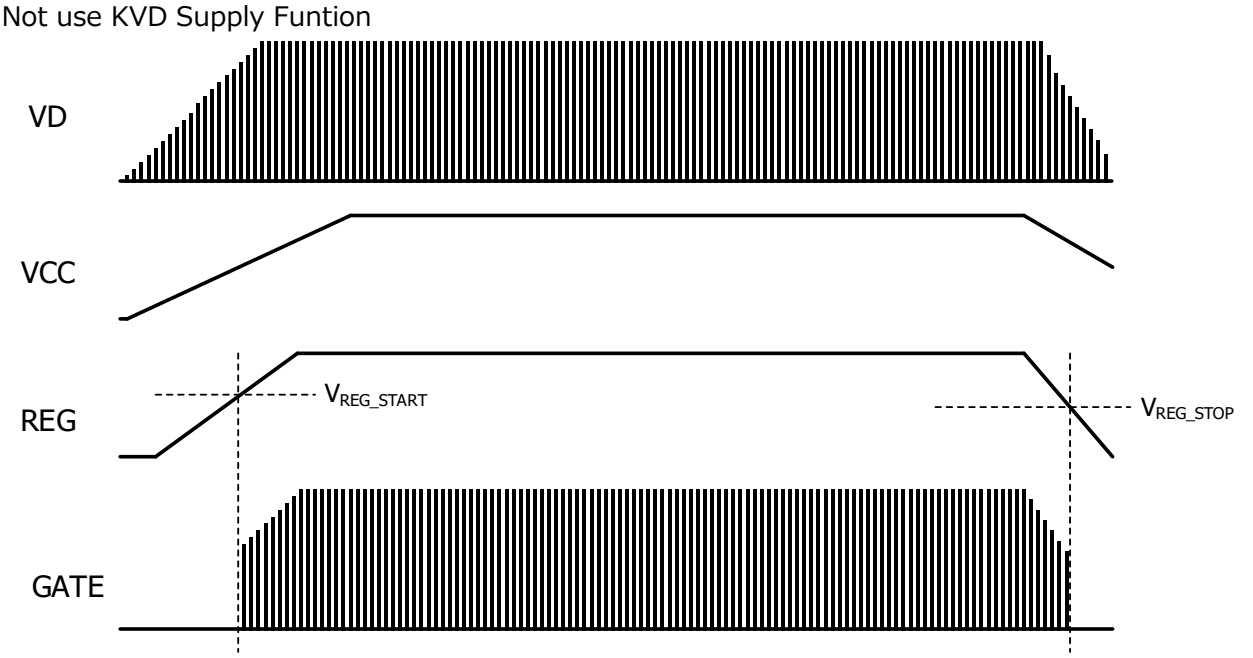
Test Circuit I



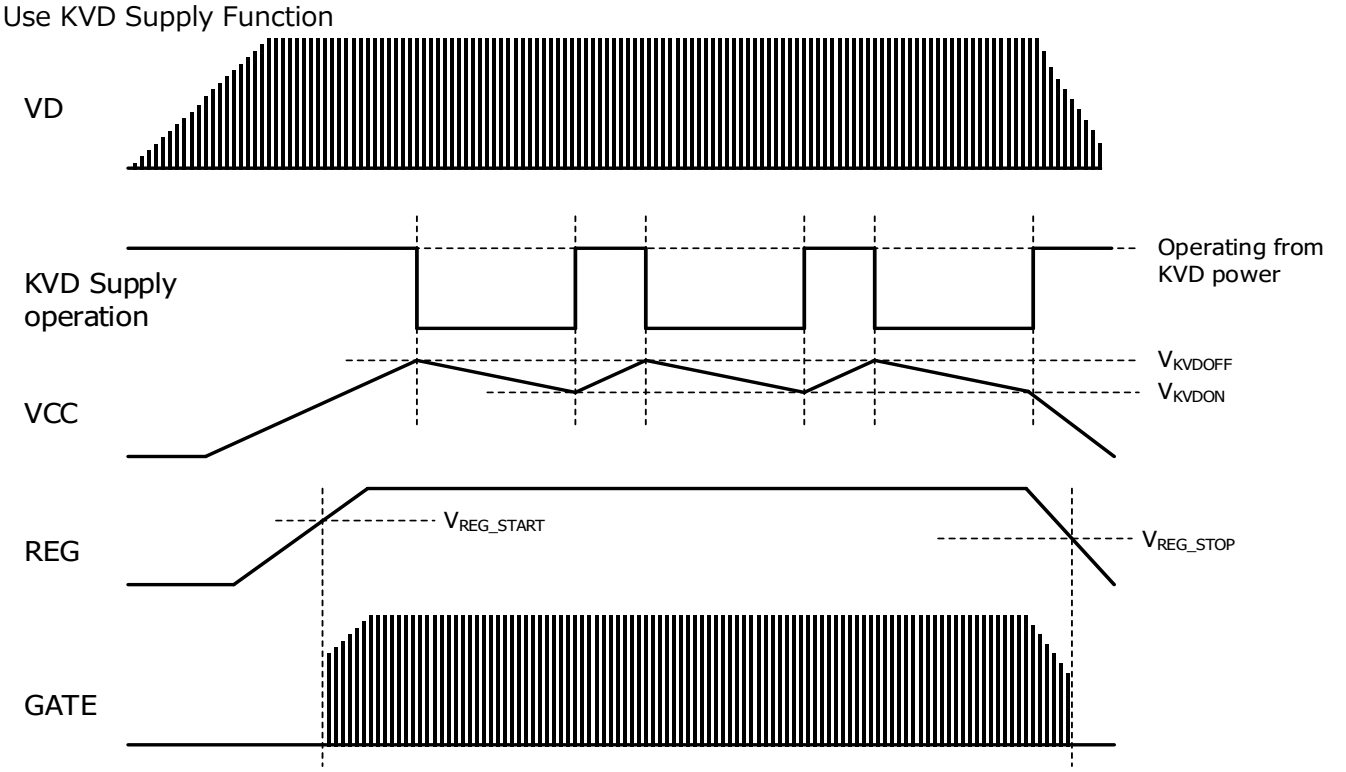
Timing chart : IC operating start to stop

A RANK

Not use KVD Supply Funtion



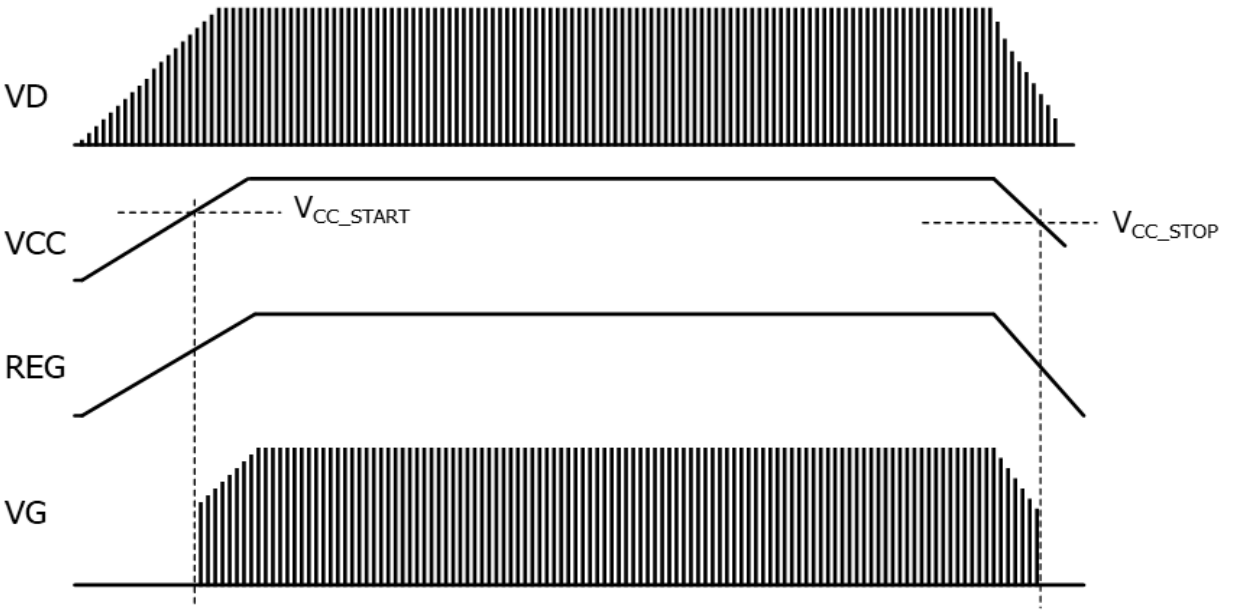
Use KVD Supply Function



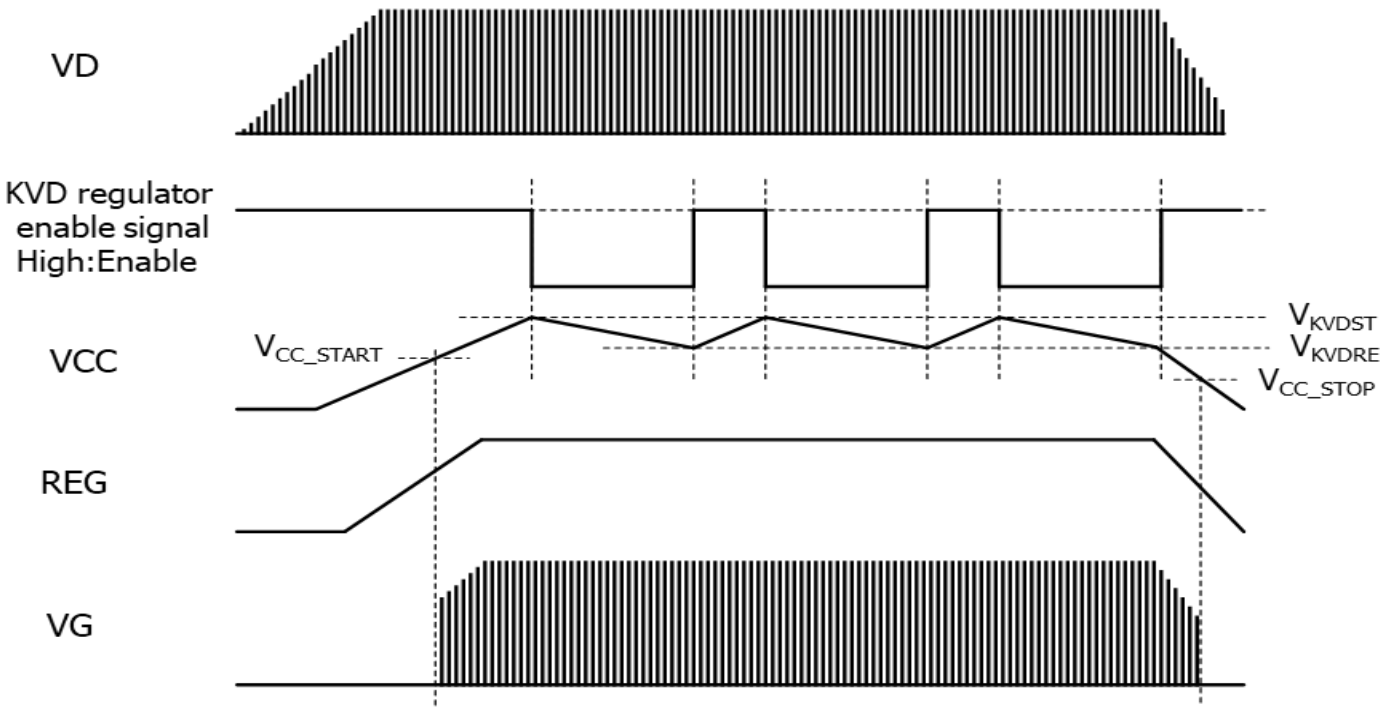
Timing chart : IC operating start to stop

B, C, D Rank

Not use KVD Supply Funtion

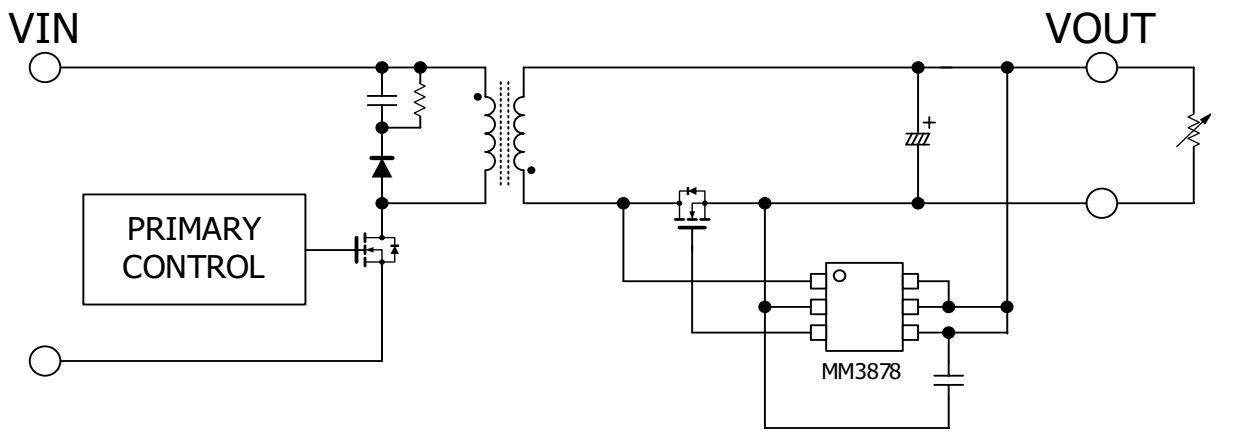


Use KVD Supply Funtion

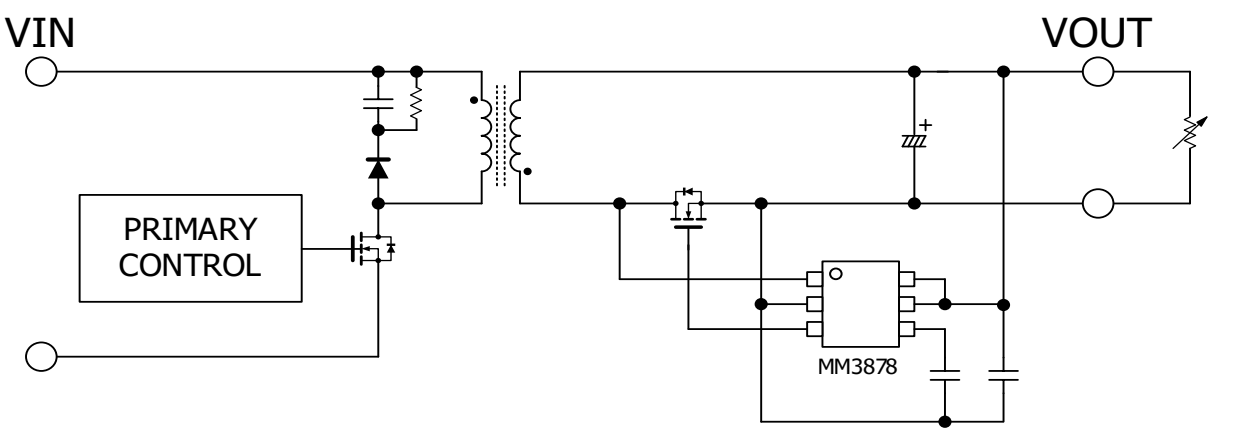


Application Circuit

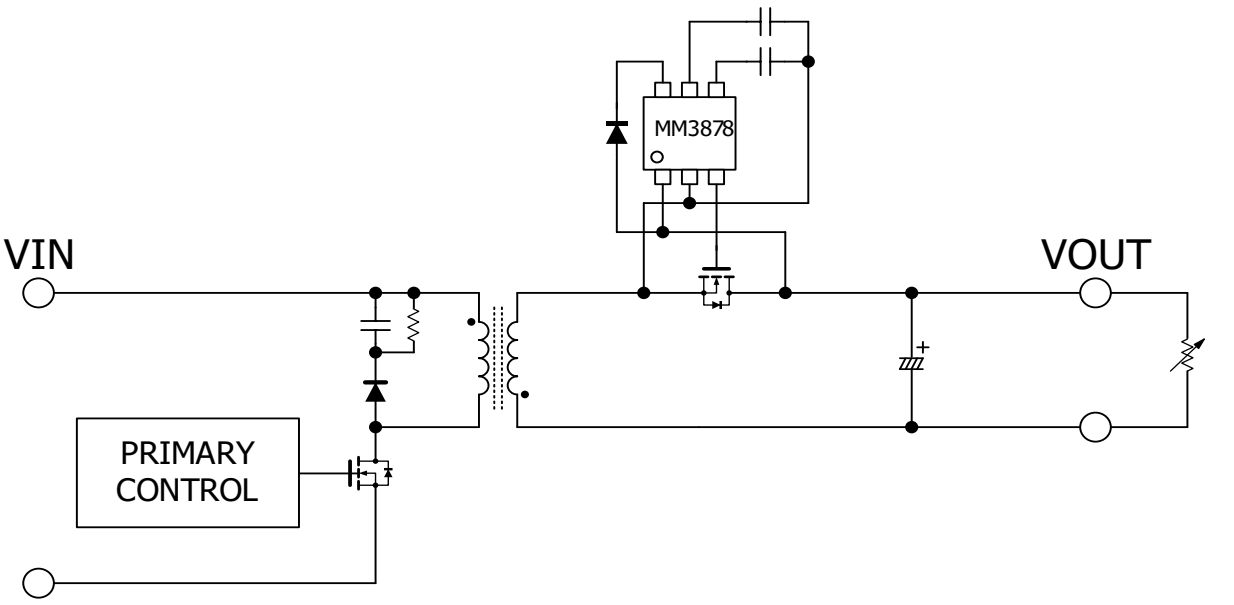
4.75V< VOUT < 6.5V (B, C, D Rank)



6.5V< VOUT < 34V (A, B, C, D Rank)

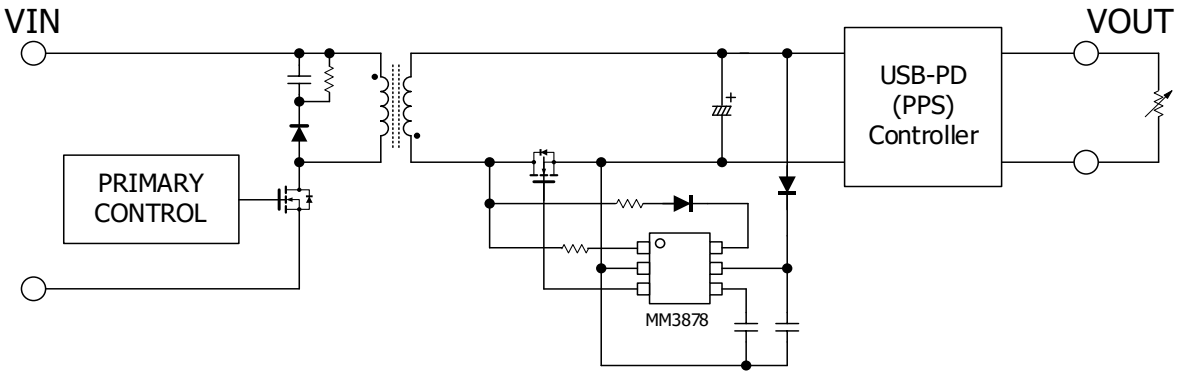


High Side Rectification (A, B, C, D Rank)



Application Circuit

USB (PPS) Power Delivety (Output Voltage: 3.3 to 20V)



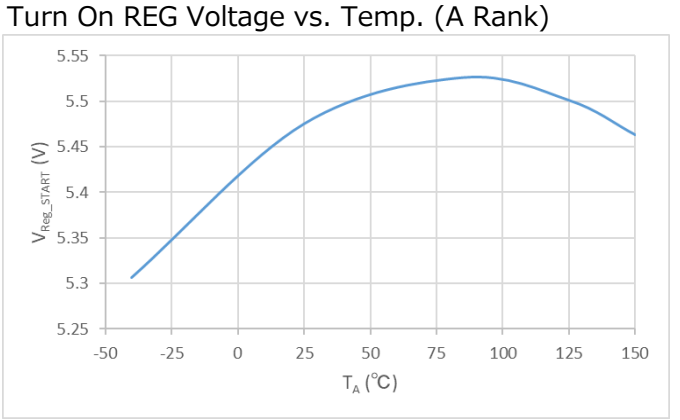
Attention

- The avove circuit shows example of connection of MM3878.
  Please refer to an application note for the setting methods of neighboring parts.

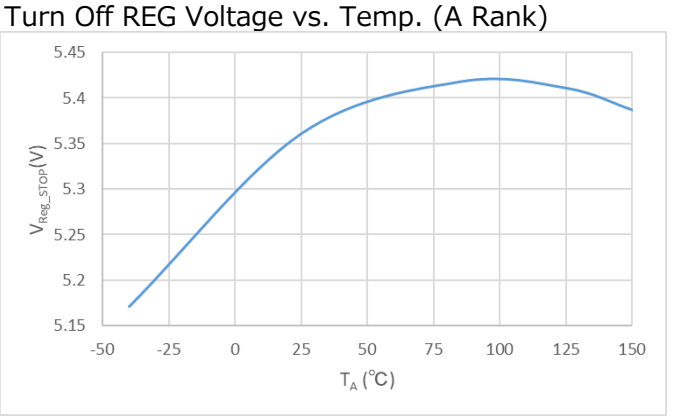
Typical Performance Characteristics

(unless otherwise T_A=25℃)

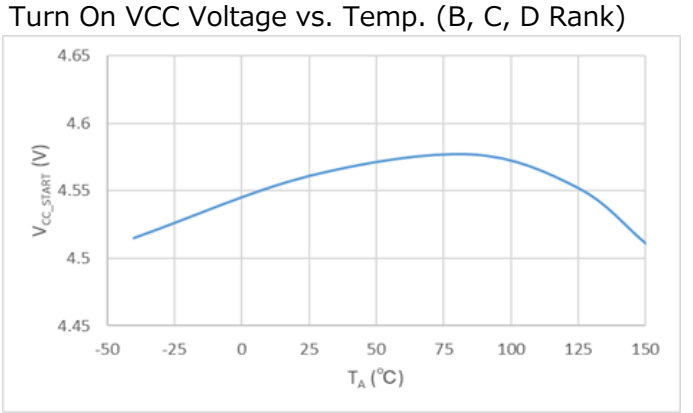
Turn On REG Voltage vs. Temp. (A Rank)



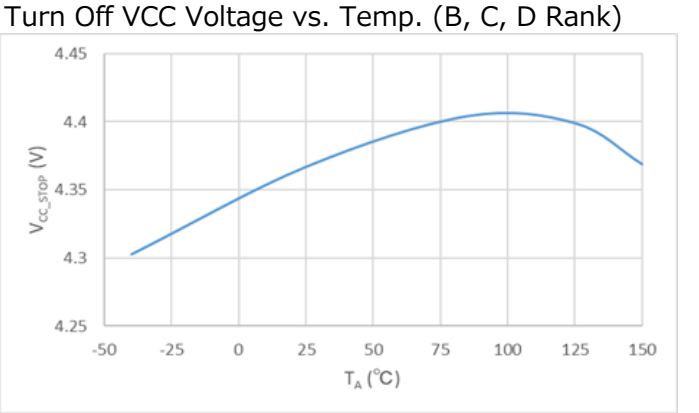
Turn Off REG Voltage vs. Temp. (A Rank)



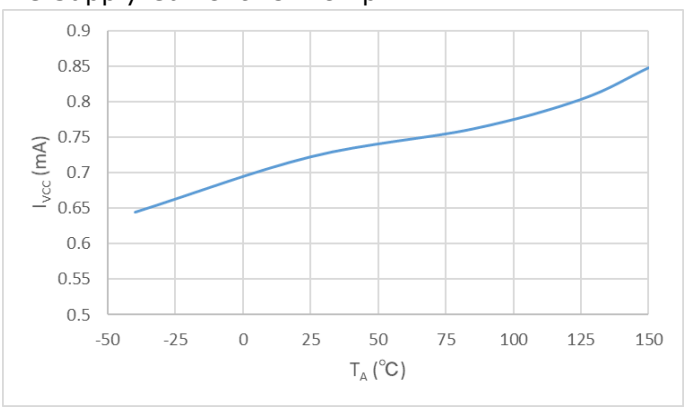
Turn On VCC Voltage vs. Temp. (B, C, D Rank)



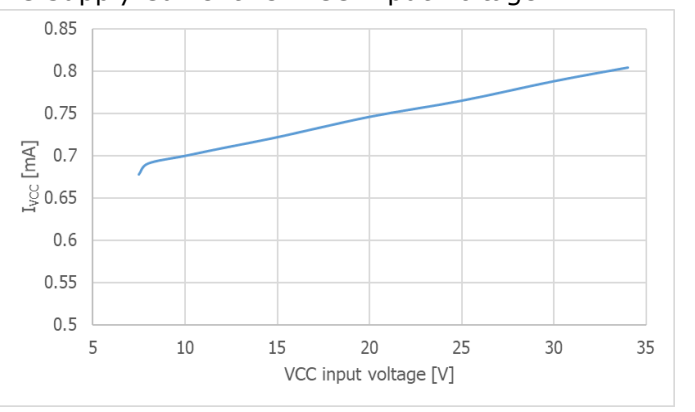
Turn Off VCC Voltage vs. Temp. (B, C, D Rank)



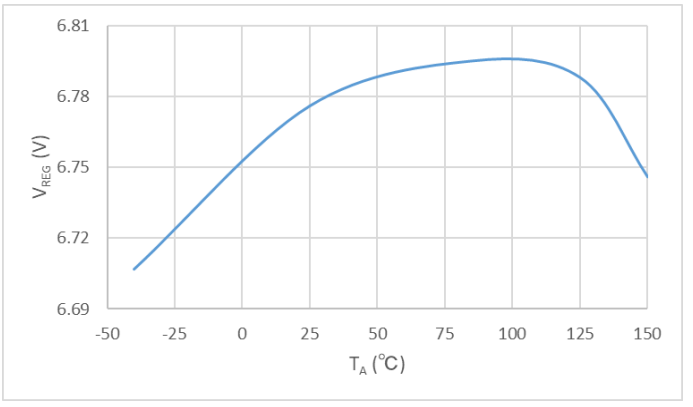
IC Supply Current vs. Temp.



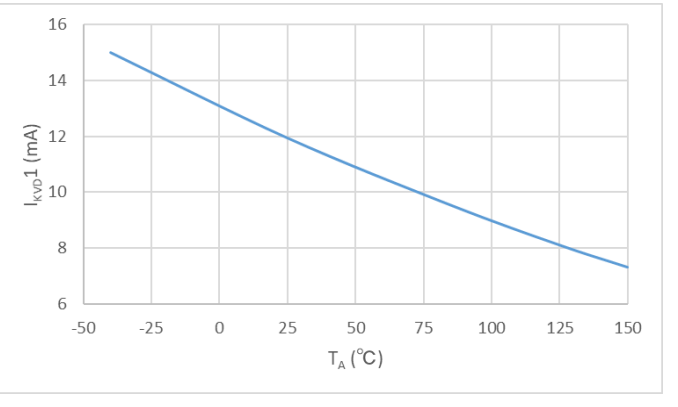
IC Supply Current vs. VCC Input Voltage



REG Output Voltage vs. Temp.



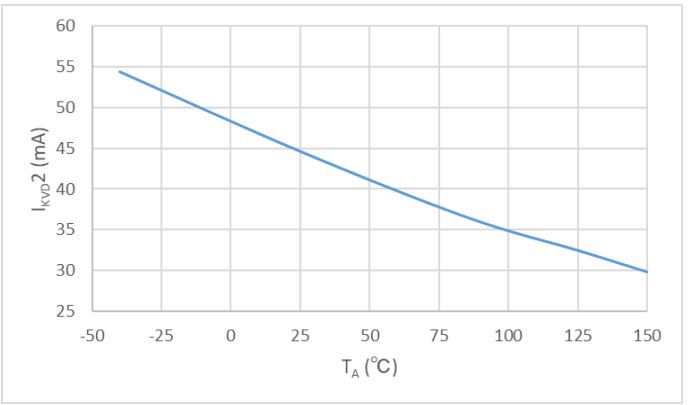
KVD Input Voltage 1 vs. Temp.



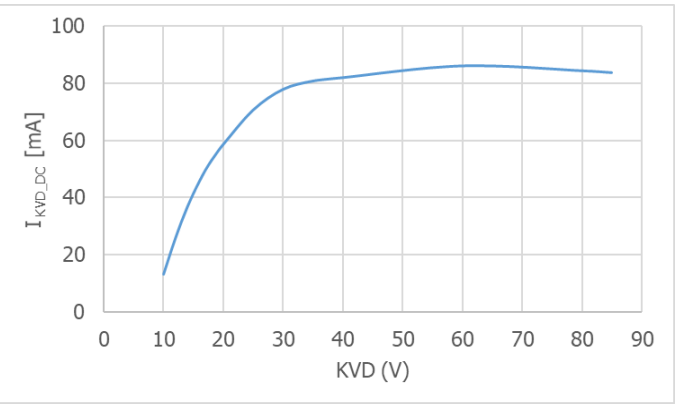
Typical Performance Characteristics

(unless otherwise T_A=25℃)

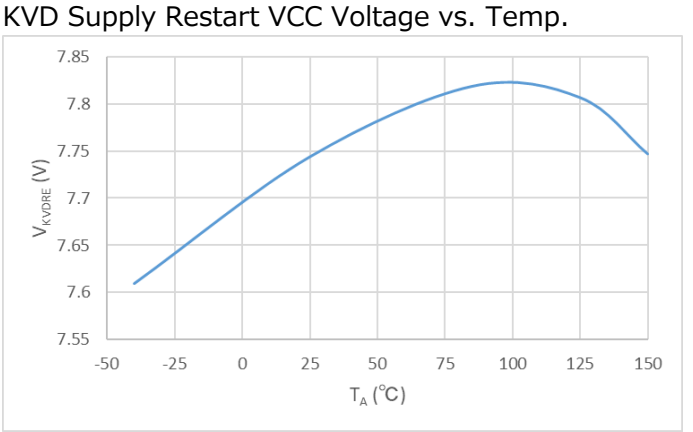
KVD Input Voltage 2 vs. Temp.



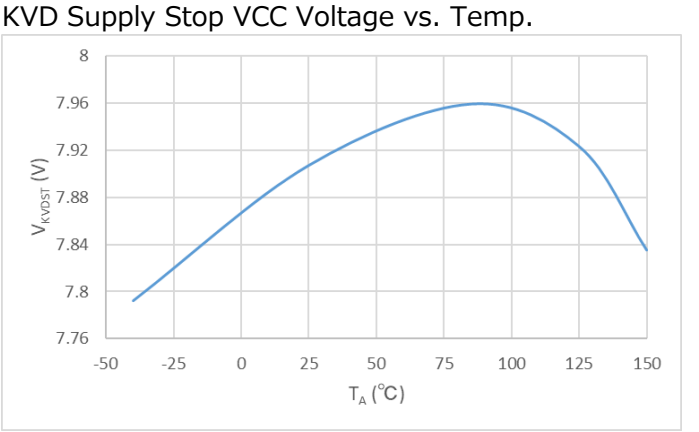
KVD Input Current vs. KVD Input Voltage



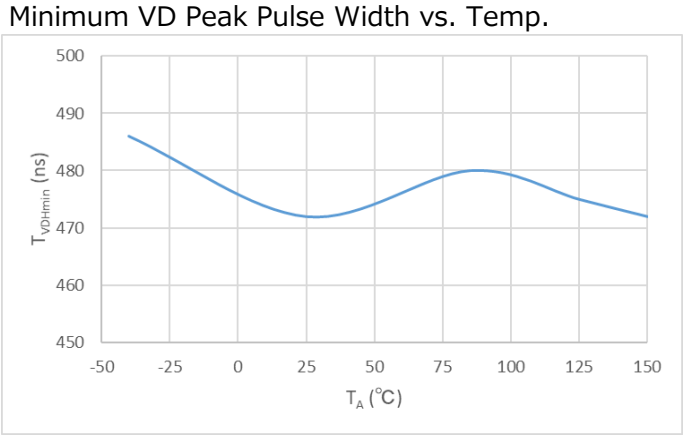
KVD Supply Restart VCC Voltage vs. Temp.



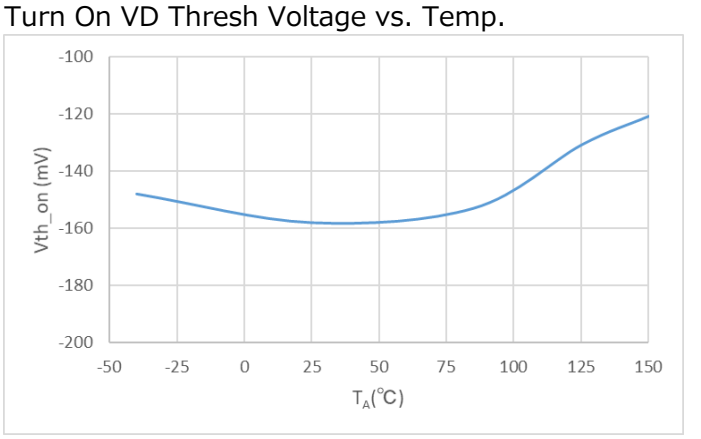
KVD Supply Stop VCC Voltage vs. Temp.



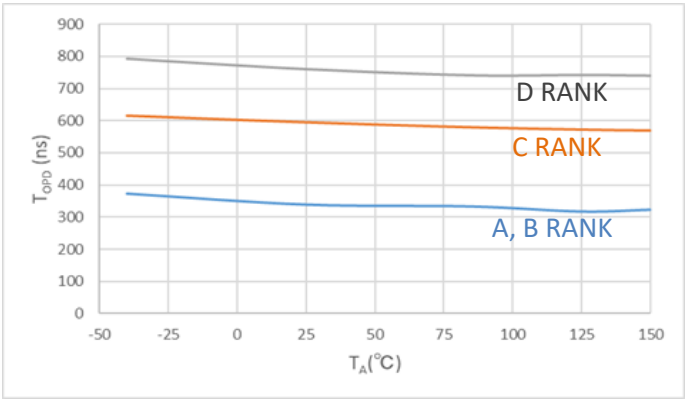
Minimum VD Peak Pulse Width vs. Temp.



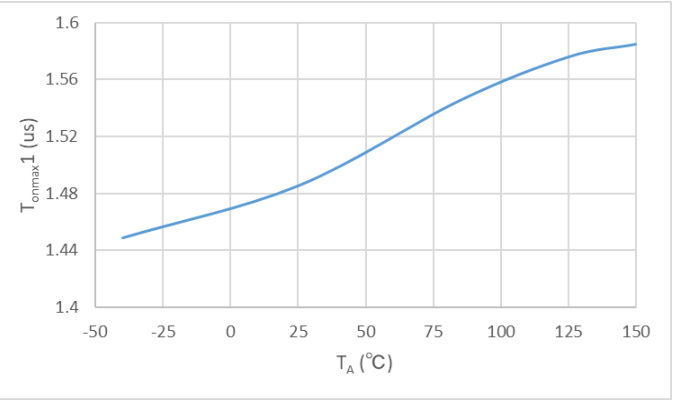
Turn On VD Thresh Voltage vs. Temp.



Turn On Prohibited Delay Time vs. Temp.



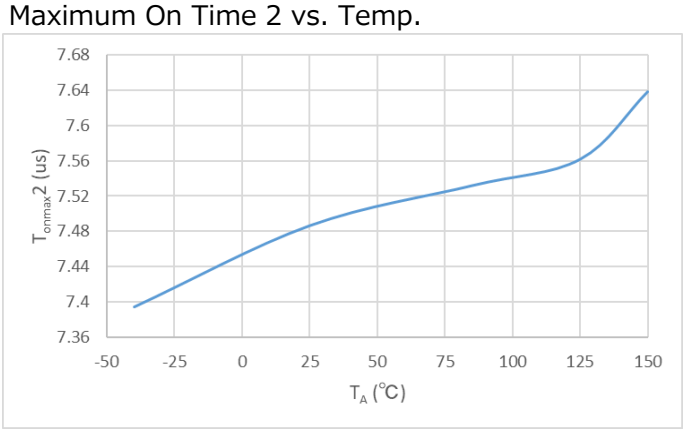
Maximum On Time 1 vs. Temp.



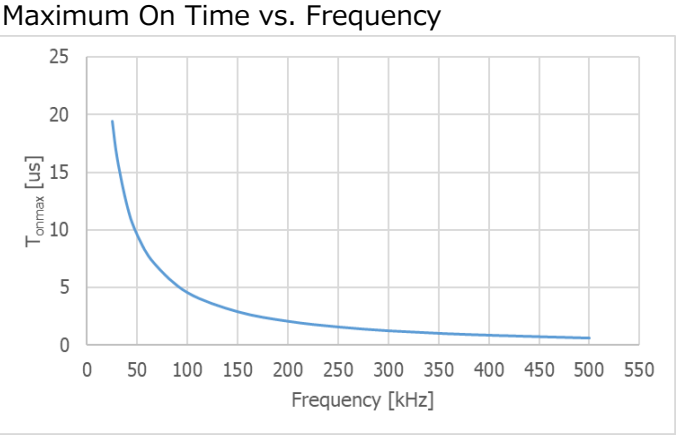
Typical Performance Characteristics

(unless otherwise T_A=25℃)

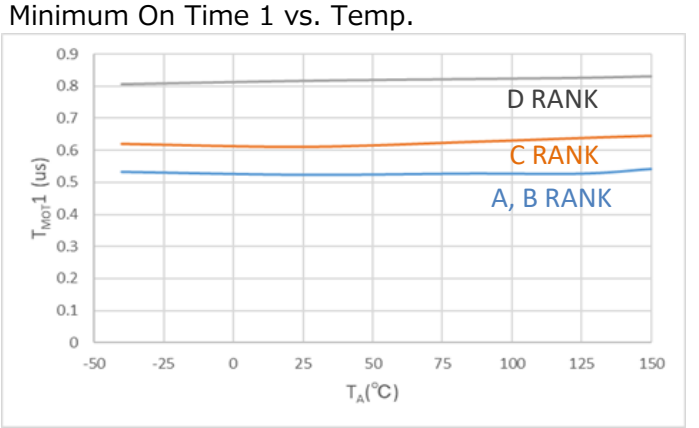
Maximum On Time 2 vs. Temp.



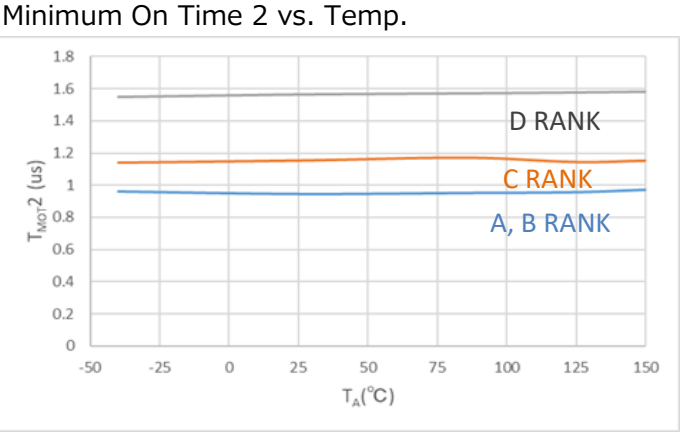
Maximum On Time vs. Frequency



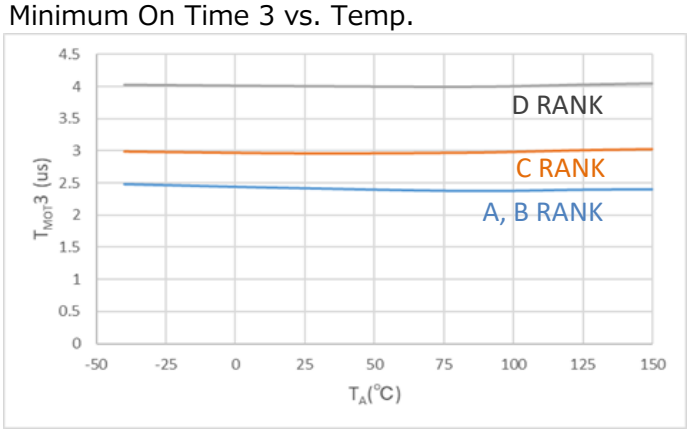
Minimum On Time 1 vs. Temp.



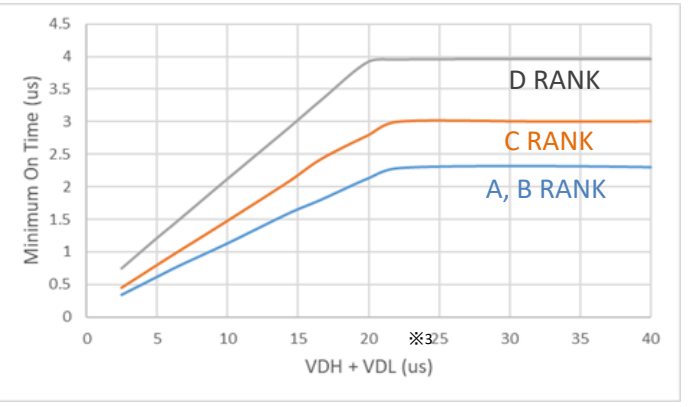
Minimum On Time 2 vs. Temp.



Minimum On Time 3 vs. Temp.

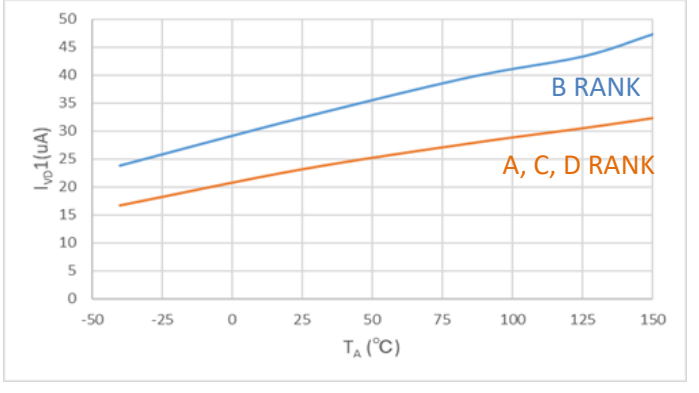


Minimum On Time vs. VDH + VDL Period

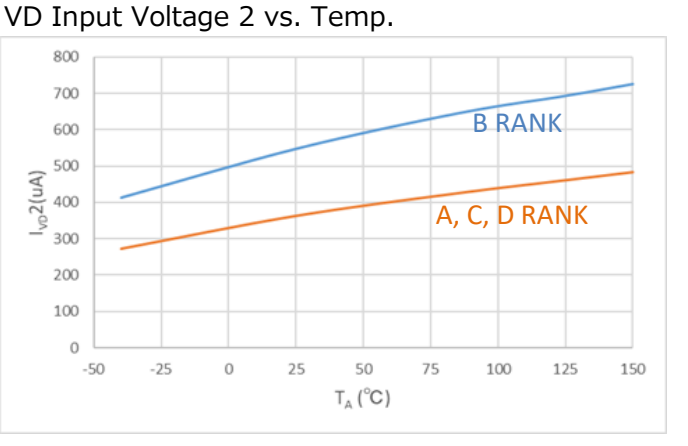


※3 VDH: VD High Period, VDL: VD Low Period

VD Input Voltage 1 vs. Temp.



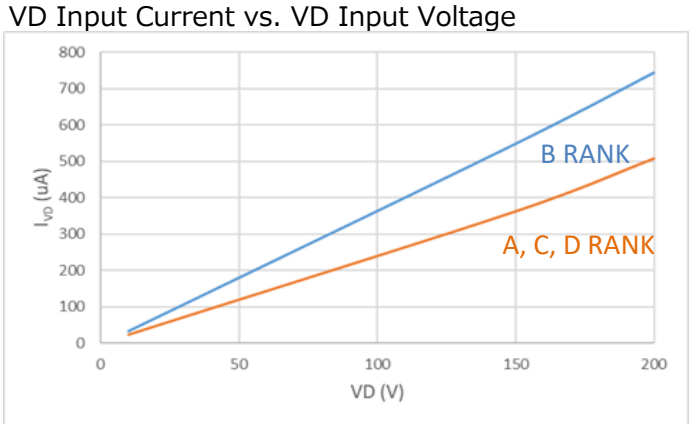
VD Input Voltage 2 vs. Temp.



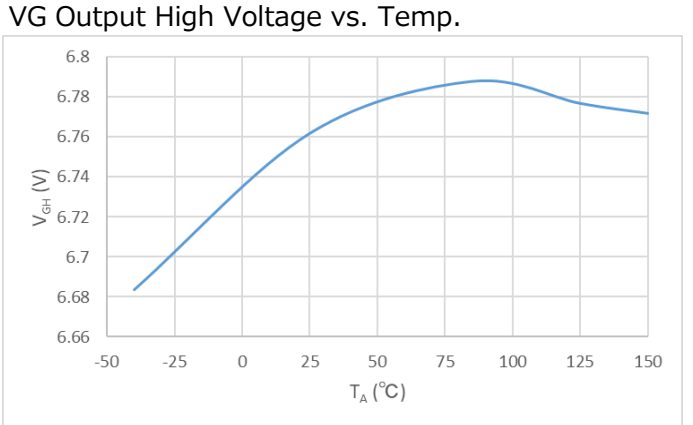
Typical Performance Characteristics

(unless otherwise T_A=25℃)

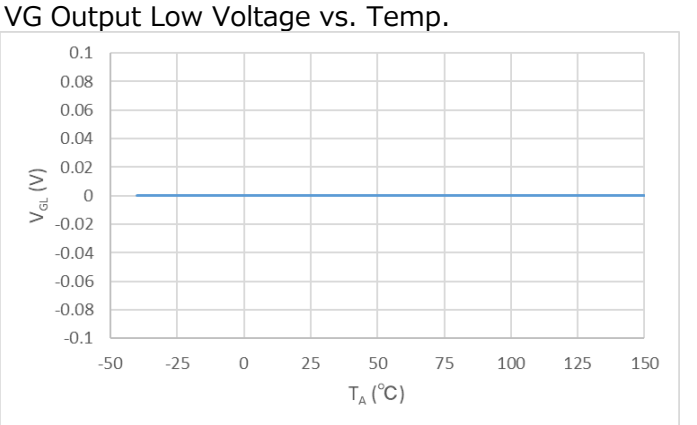
VD Input Current vs. VD Input Voltage



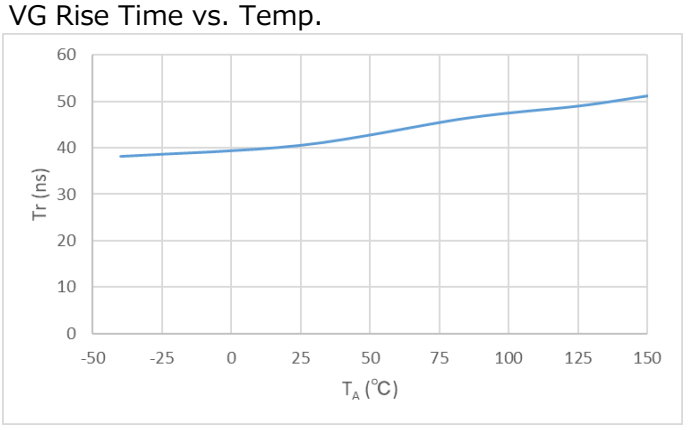
VG Output High Voltage vs. Temp.



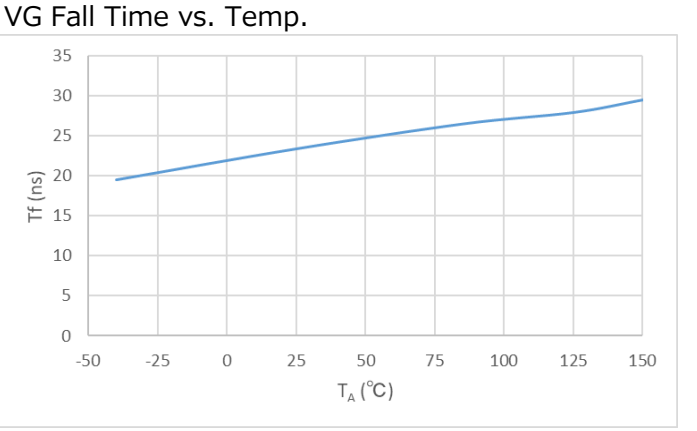
VG Output Low Voltage vs. Temp.



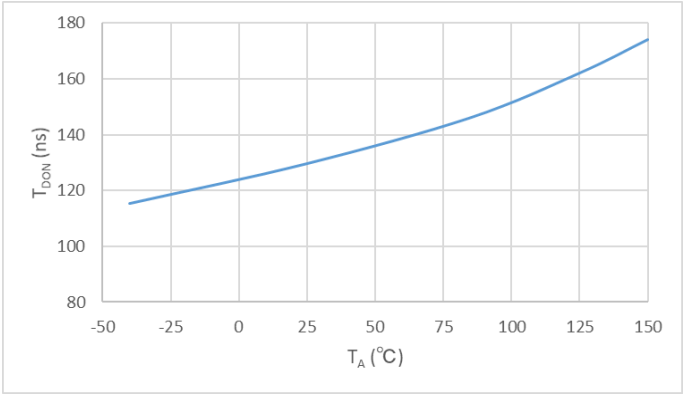
VG Rise Time vs. Temp.



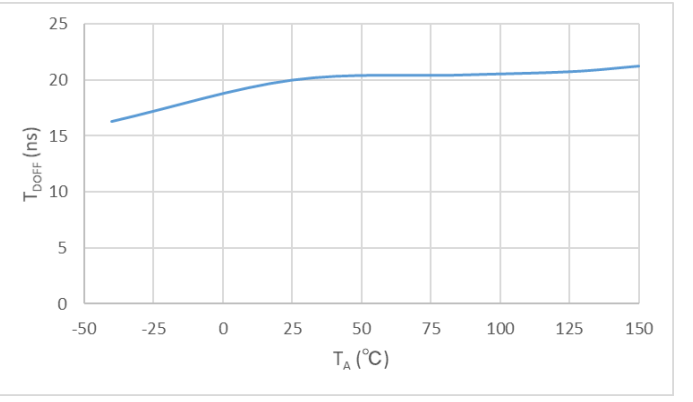
VG Fall Time vs. Temp.



Turn On Delay Time vs. Temp.



Turn Off Delay Time vs. Temp.



Dimensions

Package : SOT-26E

UNIT	mm