The PWM control IC for AC-DC converter
Monolithic IC MM3663 Series

Outline

This IC is the current mode PWM controller IC, designed for flyback converter. This IC can substantially reduce standby power by the start up circuit using the 500V high breakdown process, burst mode operating in low load, and optimization of supply current. Frequency reduction function in load of middle range and minimum frequency limit function prevent chattering noise in low load, and improve average efficiency. Select function of maximum frequency (66kHz or 100kHz) and adjustment function of FB pin voltage for oscillation stop which is innovation expand flexibility of the power supply design. Others, frequency jittering function, X capacitor discharge function make the measures of EMI easy. The M3663 which has various protection functions can assist safety design of power supply.

Features

1. Start up circuit by 500V high breakdown process reduce start up circuit loss.
2. Current mode PWM controller (select function of maximum oscillating frequency, 66kHz or 100kHz)
3. Frequency reduction function in load of middle range improve avearge efficiency.
4. Low voltage of UVLO and low supply current in oscillation stop reduce standby power more.
5. Noise diffusion, downsize filter by frequency jitter function in all range.
6. X capacitor discharge function which don't increase standby power can make the measures of EMI easy.
7. Seam of burst mode and continuous oscillation mode can be arbitrarily adjusted.Balance adjustment between standby power and output ripple.
8. Input voltage correction function of load current in over current protection realize flat correction characteristics.
9. Substantial protection functions included, current detect pin open detection, auxiliary winding short detection, and so on.
10. The CB certification in the X capacitor discharge function is acquired.
    [IEC60065, IEC60950-1, IEC62368-1]

Package

SOP-8J

Applications

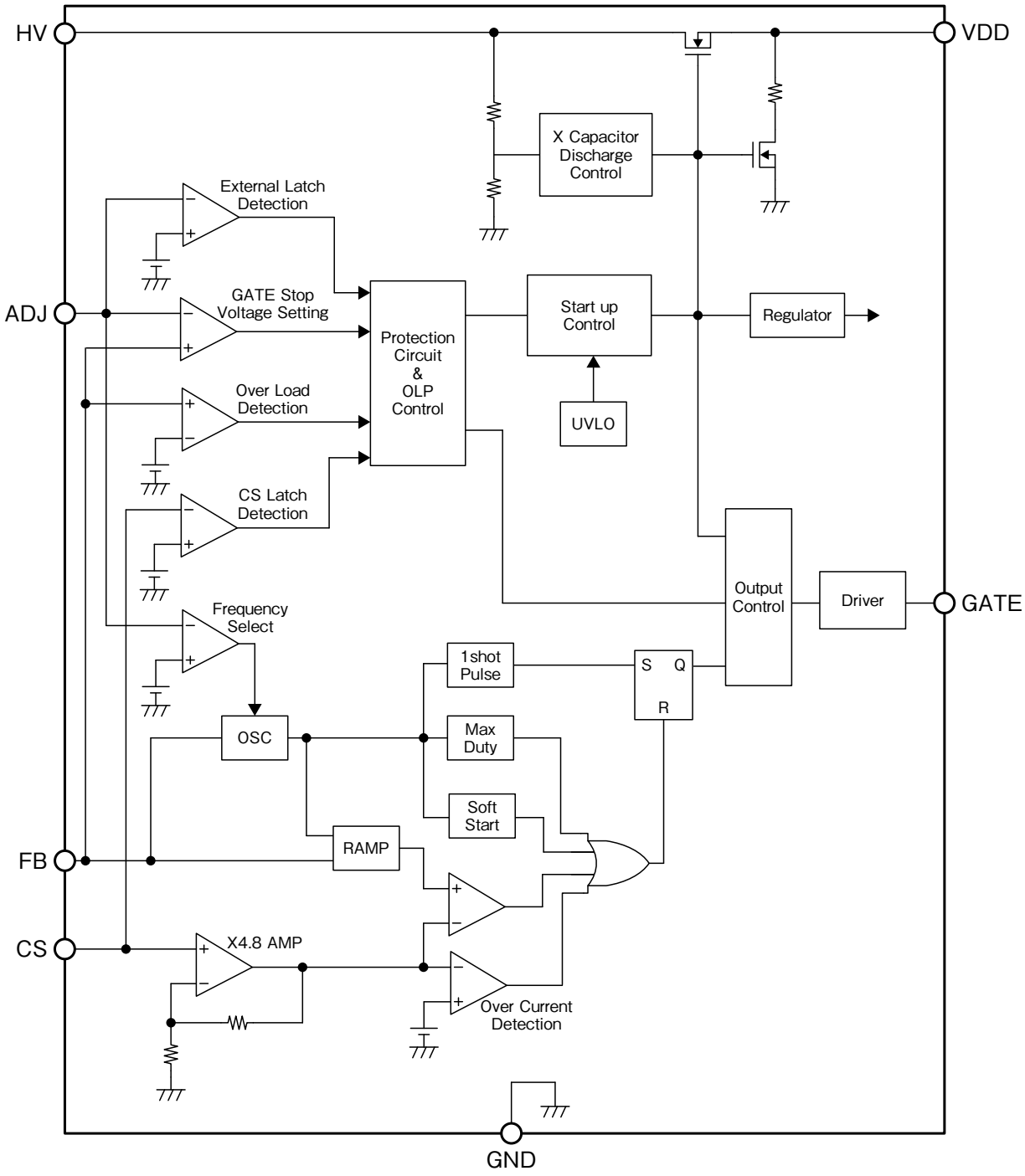
1. Flat panel TV
2. DVD Player, BD Player, BD Recorder
3. Printer, Copying Machine, FAX
4. AC/DC Adapters
5. Various Power Supplies

Lineup

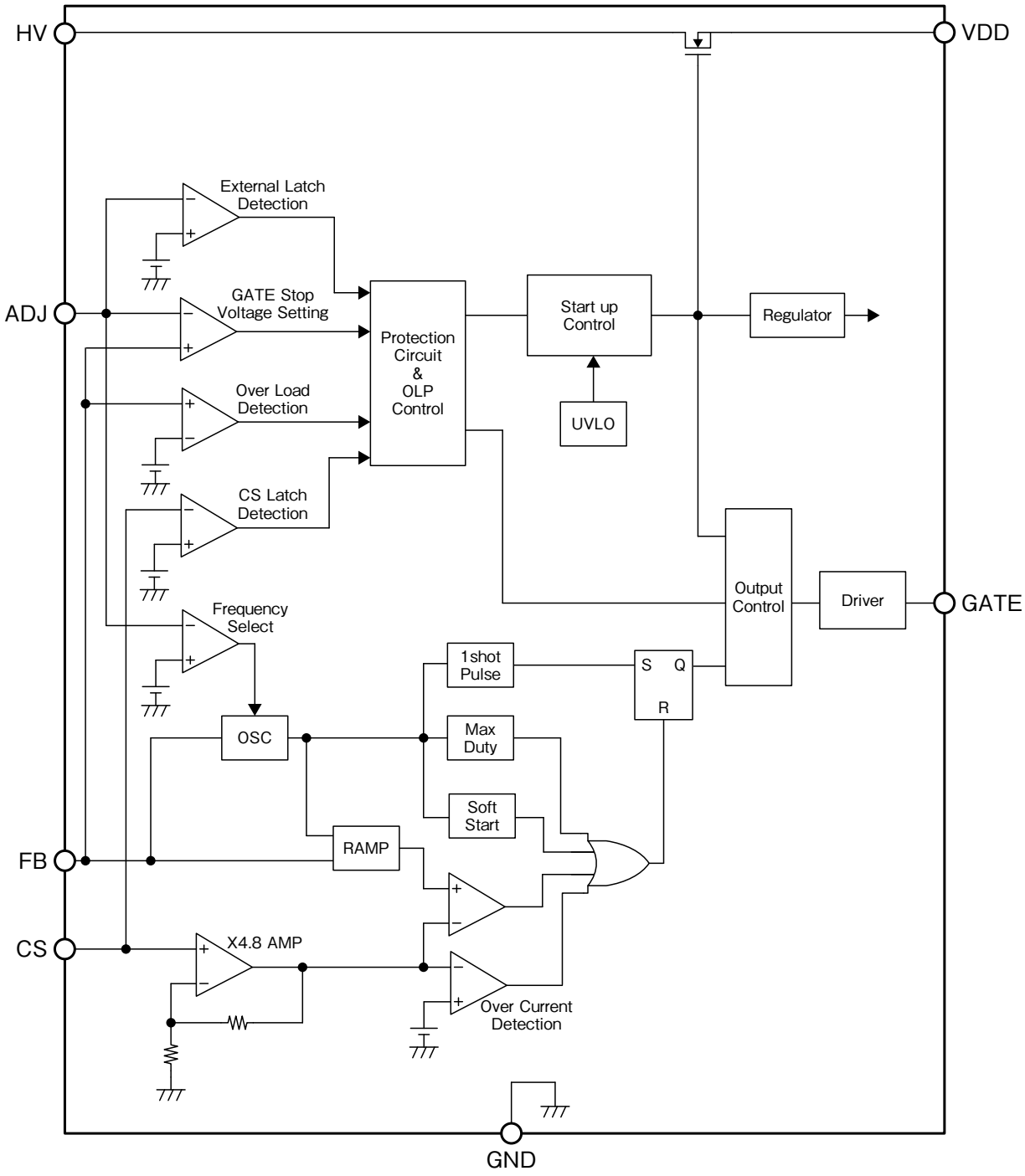
Product	Package	X-capacitor discharge	Function
MM3663AFFE	SOP-8J	○	Latch off in Over Load Protection
MM3663BFFE	SOP-8J	○	Auto restart in Over Load Protection
MM3663CFFE	SOP-8J		Latch off in Over Load Protection
MM3663DFFE	SOP-8J		Auto restart in Over Load Protection

Block Diagram

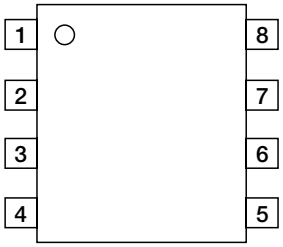
MM3663AFFE, MM3663BFFE



MM3663CFFE, MM3663DFFE



Pin Assignment



SOP-8J
(TOP VIEW)

1	ADJ
2	FB
3	CS
4	GND
5	GATE
6	VDD
7	N.C.
8	HV

Pin Description

Pin No.	Pin name	Functions
1	ADJ	GATE output stop voltage setting, external latch input, and oscillator frequency select pin
2	FB	Feedback input pin
3	CS	Current sense pin
4	GND	Ground pin
5	GATE	Output pin
6	VDD	Power supply input pin
7	N.C.	No connection
8	HV	High voltage startup pin

Absolute Maximum Ratings (Except where noted otherwise Ta=25°C)

Item	Symbol	Ratings	Units
Storage Temperature	Tstg	−40 to +150	℃
Operating Temperature	Topr	−30 to +125	
VDD Pin Voltage	VDD	−0.3 to +30	V
ADJ Pin Voltage	VADJ	−0.3 to +5	
CS Pin Voltage	VCS	−0.3 to +5	
FB Pin Voltage	VFB	−0.3 to +5	
GATE Pin Voltage	VGATE	−0.3 to VDD	
Gate Pin Peak Current	IOH	−0.5	A
	IOL	1	
HV Pin Voltage	VHV	−0.3 to +500	V
Power Dissipation	Pd	300	mW

Recommended Operating Conditions (Except where noted otherwise Ta=25°C)

Item	Symbol	Ratings	Units
Operating Supply Voltage	Vop	10 to 24	V
HV Pin Input Voltage	Vhvop	100 to 450	
HV Pin Connection Resistance	Rvh	2.2 to 22	kΩ
X Capacitor Capacitance	Cx	0.1 to 6	μF
VDD Pin Capacitance	Cvdd	10 to 100	
Operating Temperature	Top	-30 to +105	℃

Electrical Characteristics

(Except where noted otherwise VDD=15V, FB=2V, CS=0V, ADJ=0.8V, Ta=25°C)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units	Measuring Circuit
High Voltage Input Section (HV Pin)							
HV Input Current 1	Ihv1	HV=450V, VDD=23V A,B rank only	10	16	27	μA	A
HV Input Current 2	Ihv2	HV=120V, VDD=5V	7	10.5	13	mA	A
AC Interception Detect Voltage Level (Note1)	Vac	HV=120V Peak A,B rank only	65	75	85	%	A
AC Interception Detect Time	Tac	HV=120V, VDD=23V A,B rank only From VDD on until X capacitor discharge start	20	30	40	ms	A
X Capacitor Discharge Current (Note1)	Ixc	HV=120V, VDD=15V A,B rank only HV input current after Tac.	1.4			mA	A
Power Supply Input Section (VDD Pin)							
Source Current in Startup	Istr	HV=120V, VDD=5V	−12.8	−10.3	−6.8	mA	A
Source Current in Latch	Ilat	HV=120V, VDD=10V	−12	−9.5	−6	mA	A
Operating Start Voltage	Vddon	VDD=15 → 23V	19.5	21	22.5	V	B
Operating Stop Voltage	Vddoff	VDD=15 → 5V	6	6.5	7	V	B
Upper Level Voltage in Latch (Note1)	Vddlat1	In Latch			15	V	A
Lower Level Voltage in Latch (Note1)	Vddlat2	In Latch	10.5			V	A
Supply Current1	Idd1	CL=Open	0.55	0.7	0.85	mA	B
Supply Current2	Idd2	FB=0V	0.2	0.3	0.4	mA	B
Supply Current in Latch	Iddlat	In Latch, FB=5V	0.15	0.25	0.35	mA	A
VDD Over Voltage Detection	Vddovp	VDD=15 → 29.5V	25.3	27.3	29.3	V	B
VDD Over Voltage Detection Delay Time	Tvddovp	VDD=15 → 29.5V	25	50	190	μs	B
Various Function Settings Section (ADJ Pin)							
ADJ Voltage for 66kHz	Vadj1				1.21	V	B
ADJ Voltage for 100kHz	Vadj2		1.39			V	B
External Latch Stop Level	Vext	ADJ=0.5 → 0.3V	0.35			V	B
ADJ Source Current	Iadj		−4.3	−4	−3.7	μA	C
Feedback Section (FB Pin)							
Maximum Duty Cycle (Note1)	Dmax	f=Fmax	75	84	91	%	B
FB Source Current	Ifb	FB=0V	−90	−58	−40	μA	D
Gate Stop Voltage 1	Voff1	Fmax=66kHz, ADJ=0.8V	0.72	0.8	0.88	V	B
Gate Stop Voltage 2	Voff2	Fmax=100kHz, ADJ=2.24V	0.72	0.8	0.88	V	B
Gate Stop Voltage Hysteresis Range (Note1)	Voffhys	Fmax=66kHz, ADJ=0.8V		60		mV	B
Over Load Detection Voltage	Vfbolp	VDD=10V, FB=3.4 → 4.6V	3.5	4	4.5	V	B
Over Load Timer (Note1)	Tfbolp	FB=3.4 → 4.6V	190	250	310	ms	B
Restart Timer (Note1)	Trestart	FB=3.4 → 4.6V B,D rank only	1.5	2	2.5	s	B

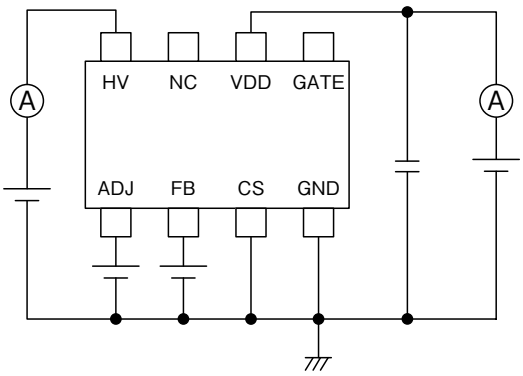
Note1 : The parameter is guaranteed by design.

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units	Measuring Circuit
Current Detection Section (CS Pin)							
Voltage Gain (Note1)	Avcs			4.8		V/V	E
Over Current Detection Voltage1 (Note1)	Vthcs1	Duty=20%	0.432	0.455	0.478	V	E
Over Current Detection Voltage2 (Note1)	Vthcs2	Duty=40%	0.508	0.535	0.562	V	E
Minimum On Time1	Tmo1	CS=1V	410	610	810	ns	E
Minimum On Time2	Tmo2	Soft Start Range Over Load Range	220	320	420	ns	E
GATE Output Delay Time (Note1)	Toff			200		ns	E
CS Source Current (Note1)	Ics			−0.8		μA	F
CS Latch Stop Detection Voltage	Vthcslat	CS=2 → 3V	2.25	2.5	2.75	V	E
Output Section (GATE Pin)							
L Output Voltage	Voutl	Iol=100mA	0.5	1.2	2.2	V	G
H Output Voltage	Vouth	Ioh=−100mA	11	12.5	14	V	H
Rise Time	Trise	CL=1nF	30	60	100	ns	I
Fall Time	Tfall	CL=1nF	20	40	70	ns	I
Soft Start Section							
Soft Start Time 1 (Note1)	Tss1	Fmax=66kHz		4.8		ms	B
Soft Start Time 2 (Note1)	Tss2	Fmax=100kHz		6.4		ms	B
Oscillator Section							
Maximum Frequency1	Fmax1		60	66	72	kHz	B
Maximum Frequency2	Fmax2	ADJ=2.24V	90	100	110	kHz	B
Frequency Change Ratio due to the power supply voltage	Fcrv	VDD=10～24V	−2		+2	%	B
Frequency Change Ratio due to temperature (Note1)	Fcrt	Ta=−30～+125℃	−5		+5	%	B
Jitta Change Ratio 1	Fjcr1	Fmax=66kHz	±3	±5.5	±8	%	B
Jitta Change Ratio 2	Fjcr2	Fmax=100kHz	±5.5	±8.5	±11.5	%	B
FB Pin Threshold Voltage at Frequency Decrease Biginning (Note1)	Vfbd		1.54	1.6	1.66	V	B
FB Pin Threshold Voltage at Frequency Increase Biginning (Note1)	Vfbi		1.44	1.5	1.56	V	B
Minimum Frequency1	Fmin1	FB=1.2V	20	22	24	kHz	B
Minimum Frequency2	Fmin2	FB=1.2V, ADJ=2.24V	19	21	23	kHz	B

Note1 : The parameter is guaranteed by design.

Measuring Circuit

(A)



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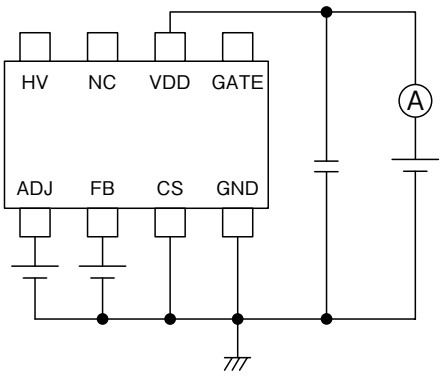

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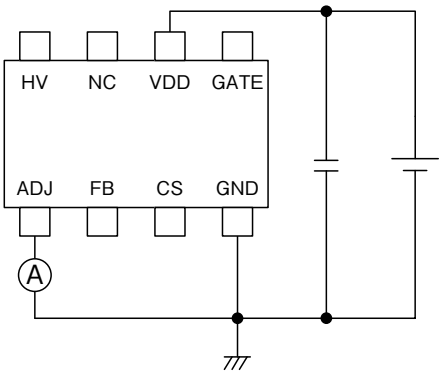

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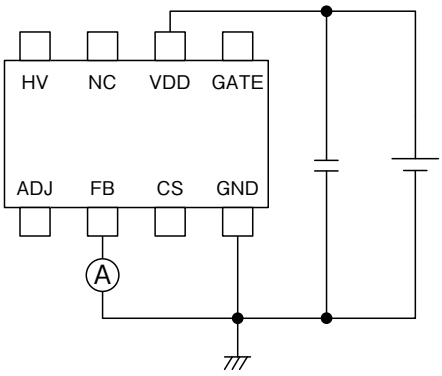

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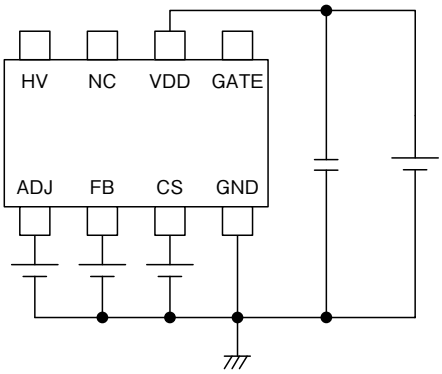

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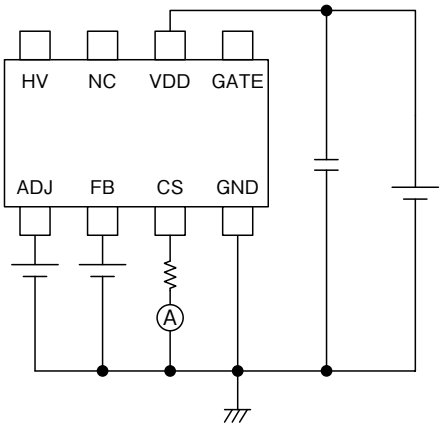

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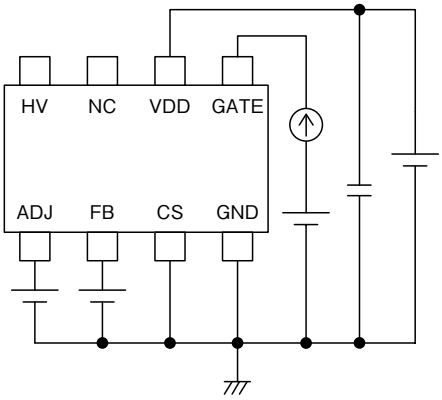

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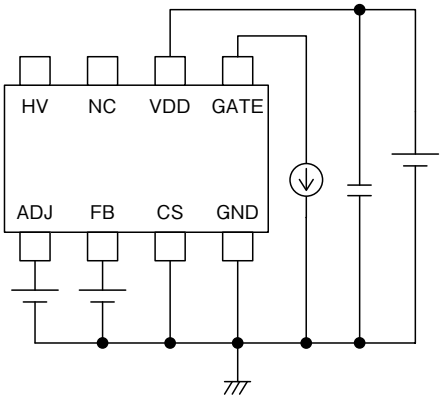
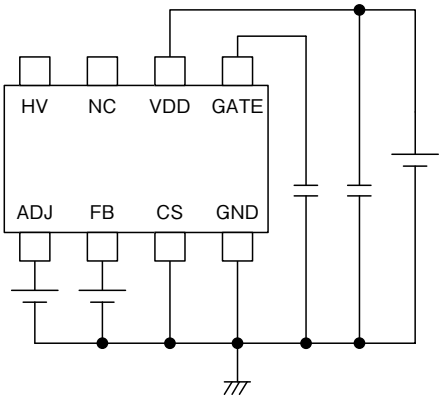
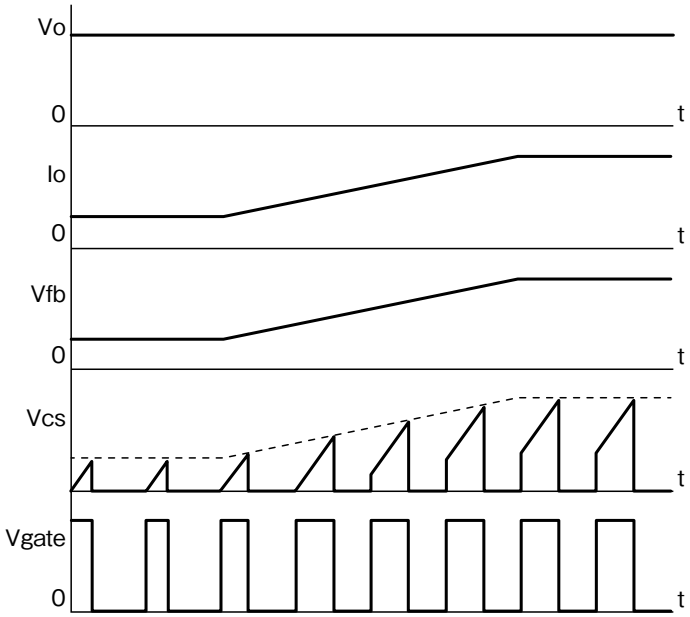


(I)

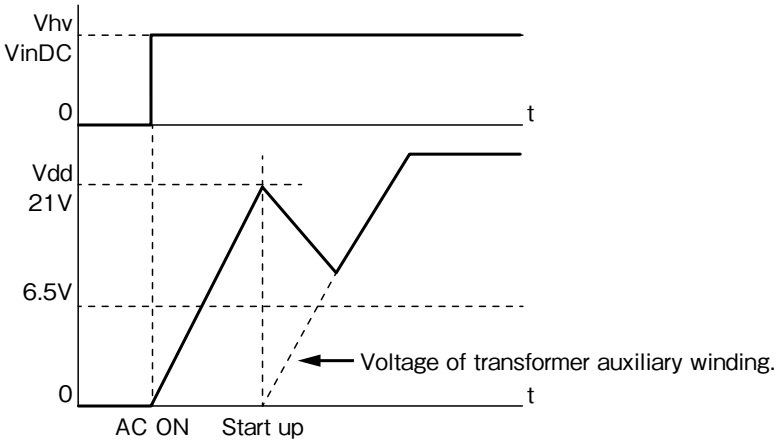


Timing Chart

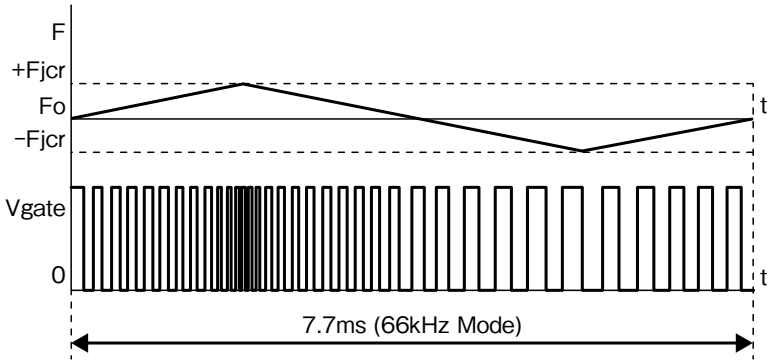
(1) Current mode control



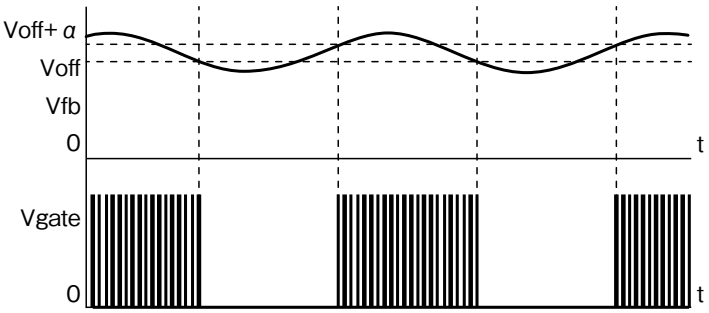
(2) VDD start up characteristics



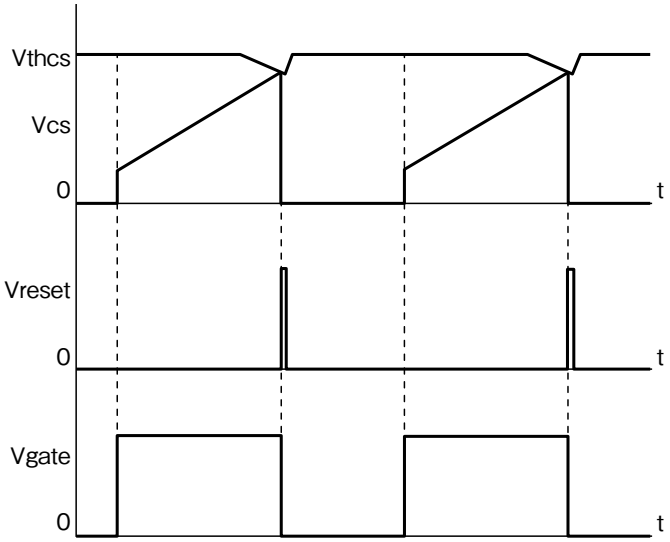
(3) Frequency jitter function



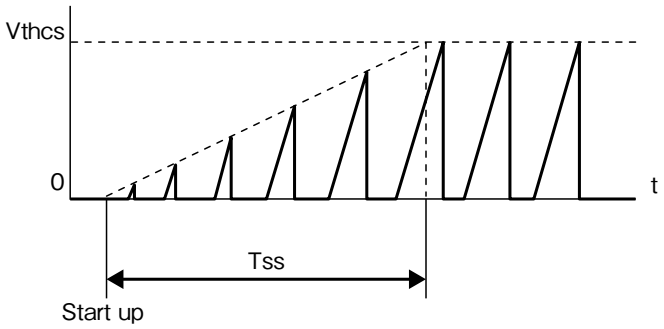
(4) Burst mode operation



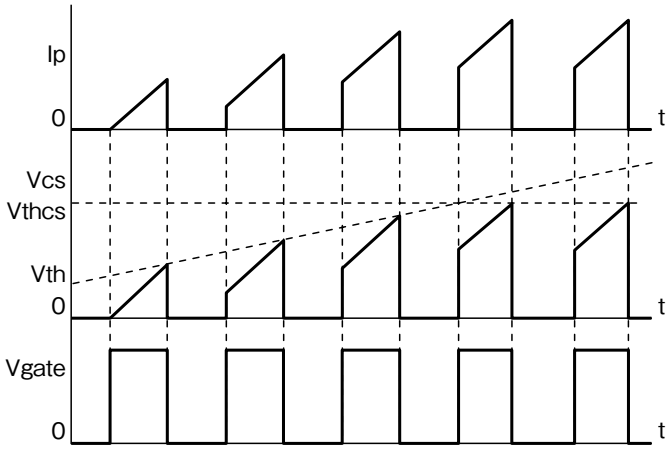
(5) Slope compensation



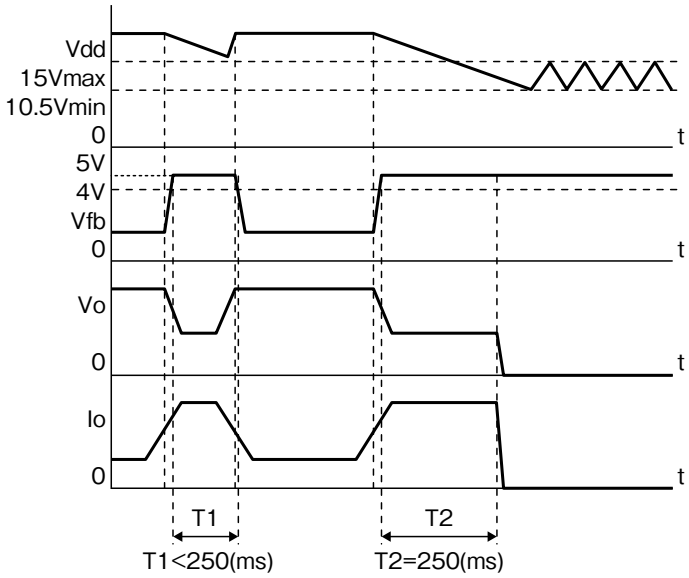
(6) Soft start



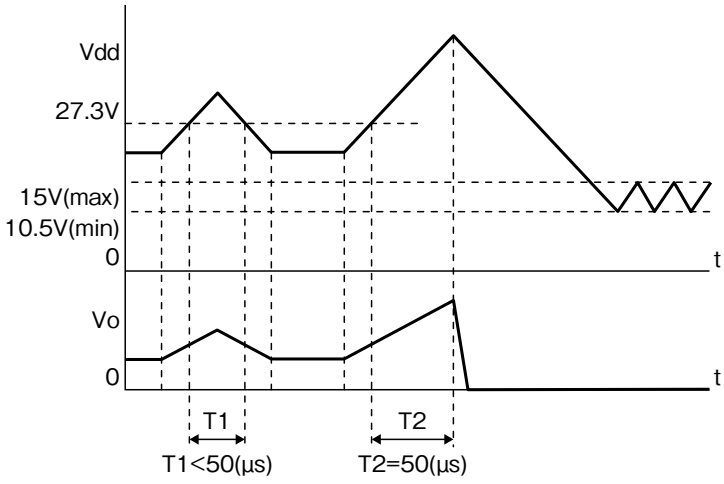
(7) Over current protection



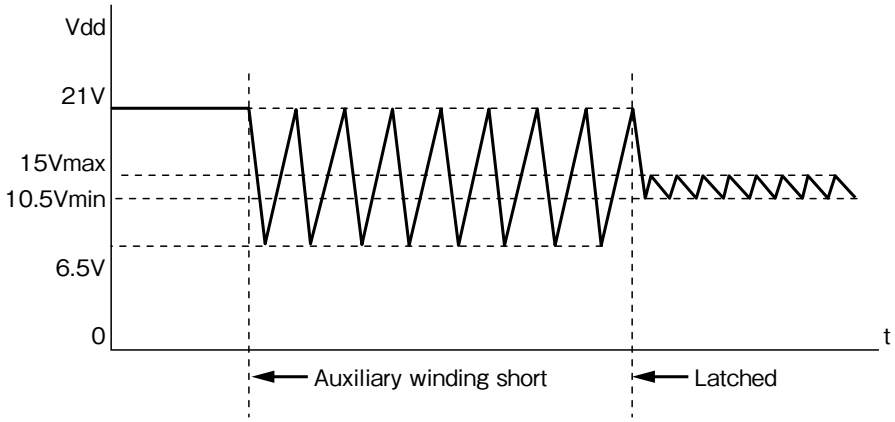
(8) Over load protection



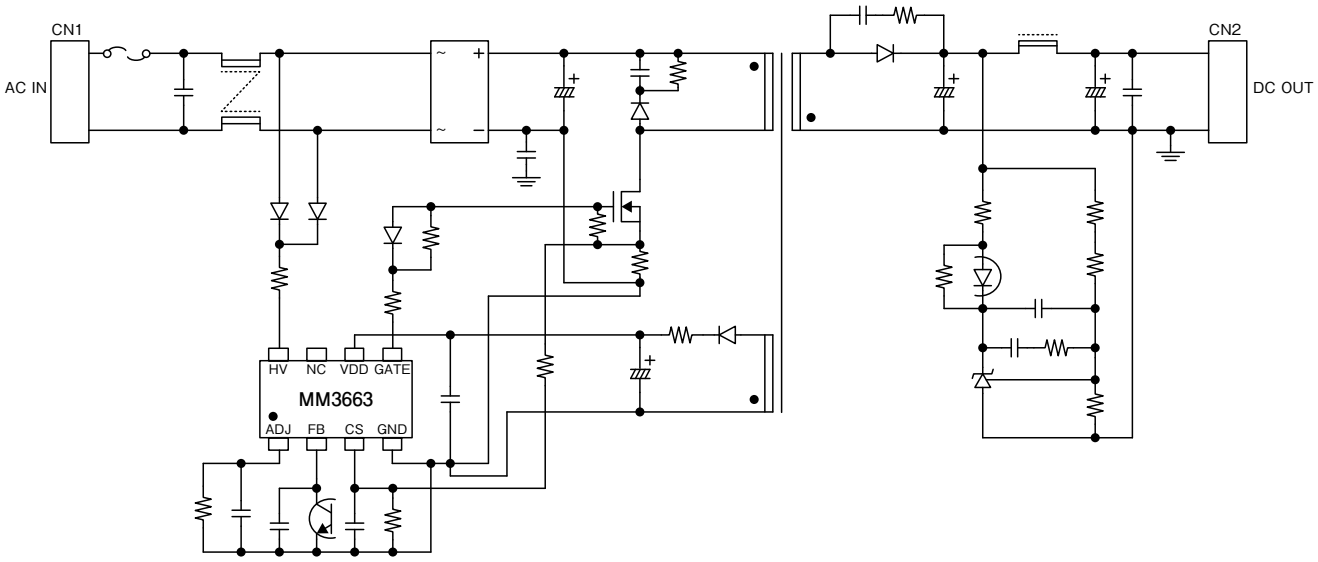
(9) Over voltage protection



(10) Auxiliary winding short protection

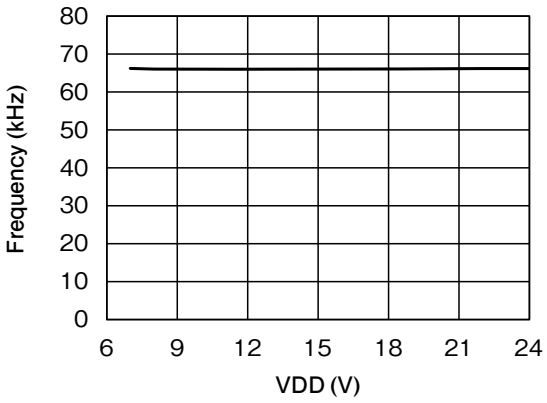


Application Circuit

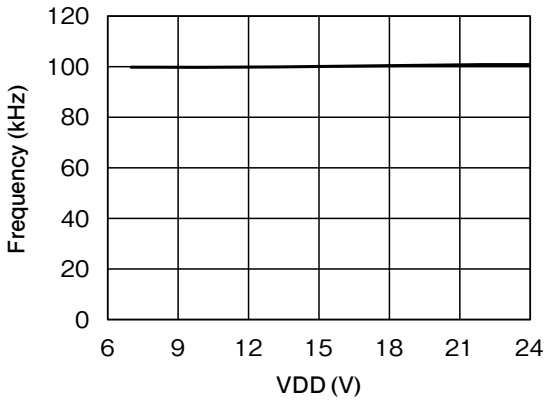


Characteristics (Except where noted otherwise Ta=25°C)

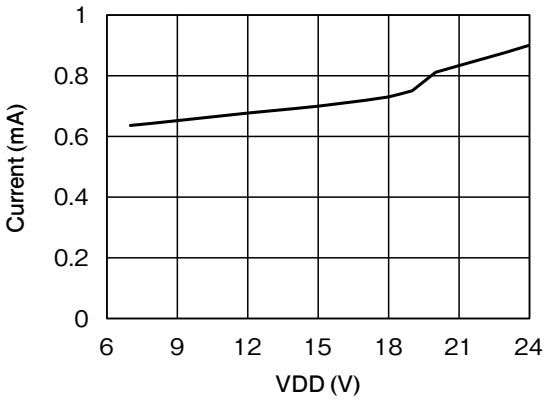
Maximum Frequency 1 – VDD Pin Voltage



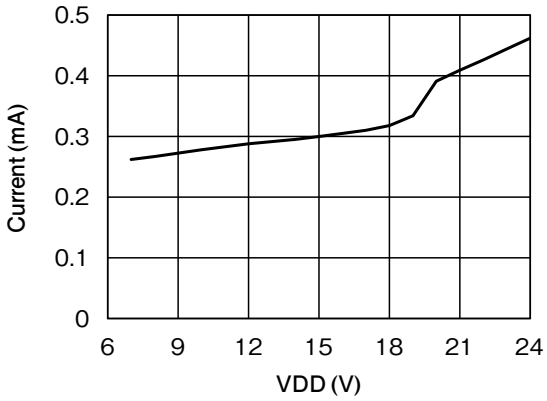
Maximum Frequency 2 – VDD Pin Voltage



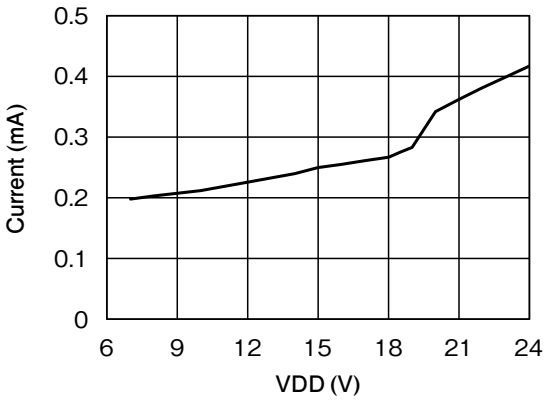
Supply Current 1 - VDD Pin Voltage



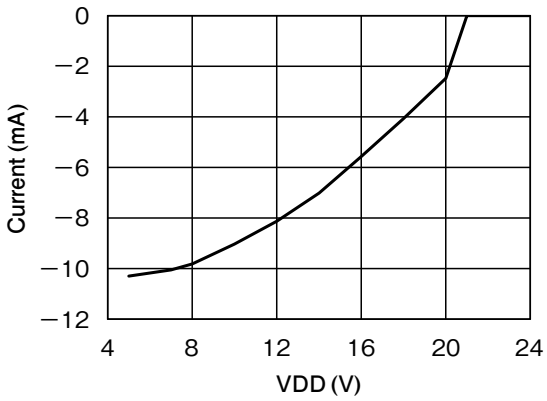
Supply Current 2 - VDD Pin Voltage



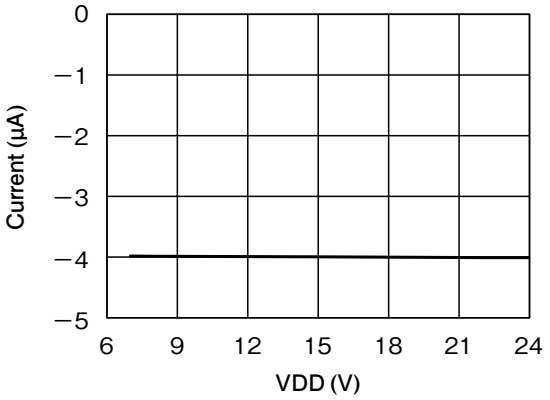
Supply Current in Latch - VDD Pin Voltage



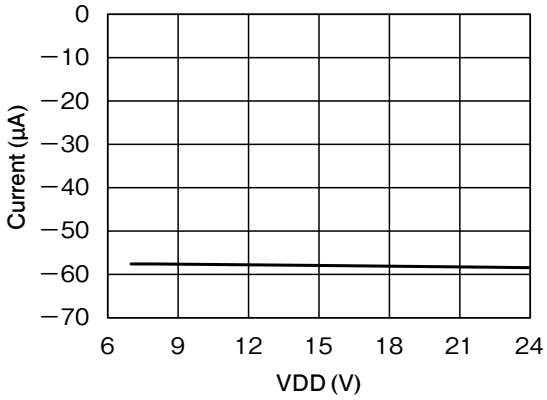
Source Current in Startup - VDD Pin Voltage



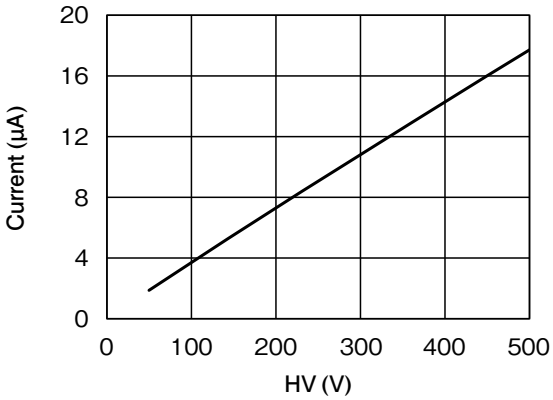
ADJ Source Current - VDD Pin Voltage



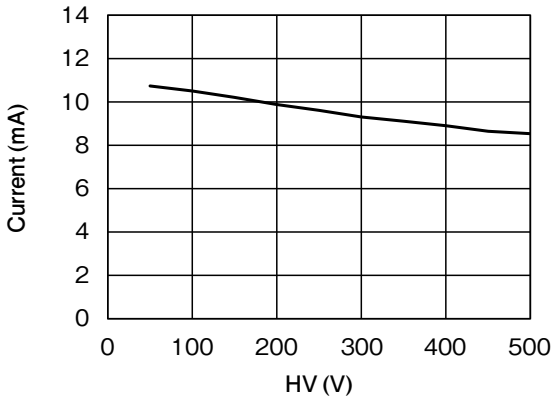
FB Source Current - VDD Pin Voltage



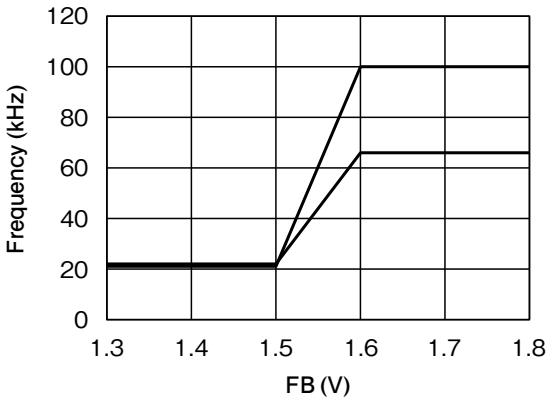
HV Input Current 1 - HV Pin Voltage



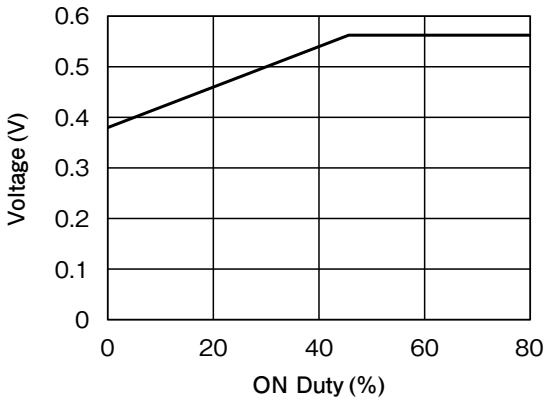
HV Input Current 2 - HV Pin Voltage



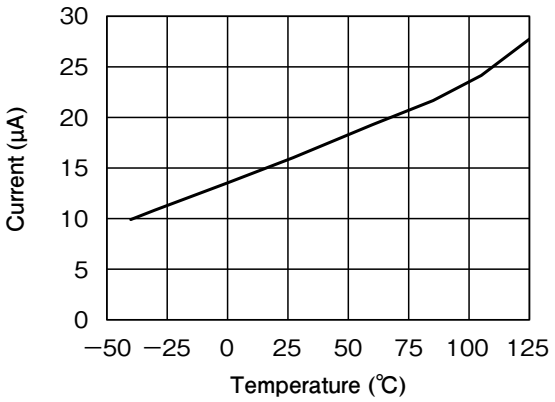
Frequency - FB Pin Voltage



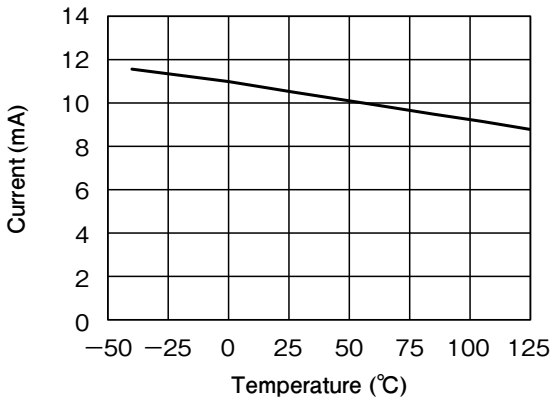
Over Current Detection Voltage - ON Duty



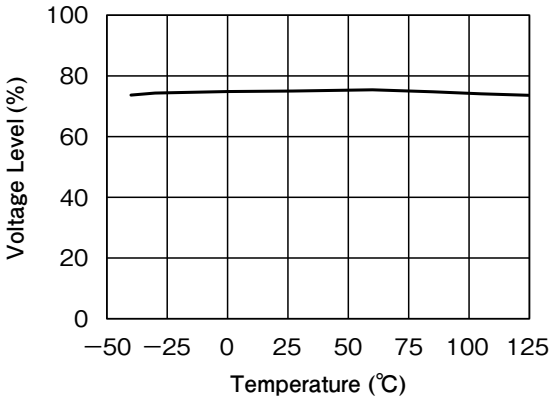
HV Input Current 1 - Temperature



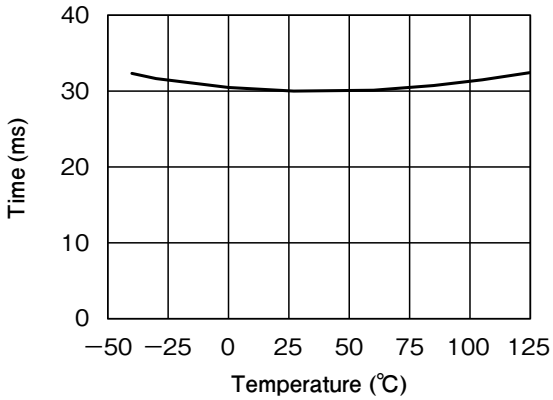
HV Input Current 2 - Temperature



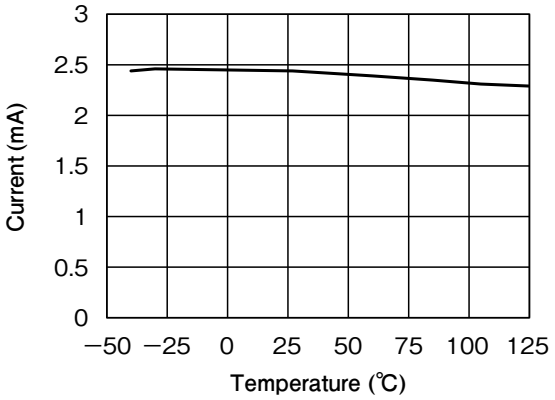
AC Interception Detect Voltage Level - Temperature



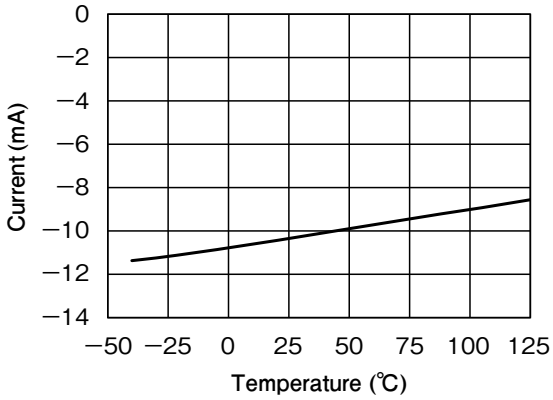
AC Interception Detect Time - Temperature



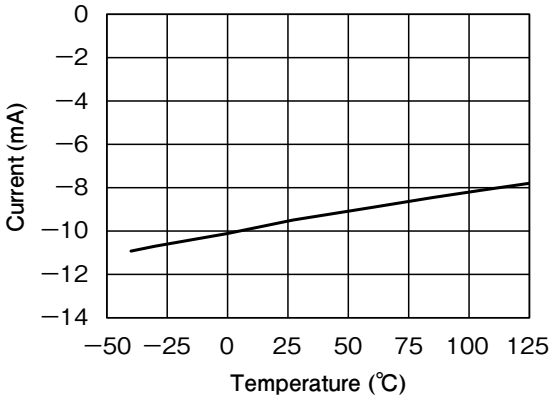
X Capacitor Discharge Current - Temperature



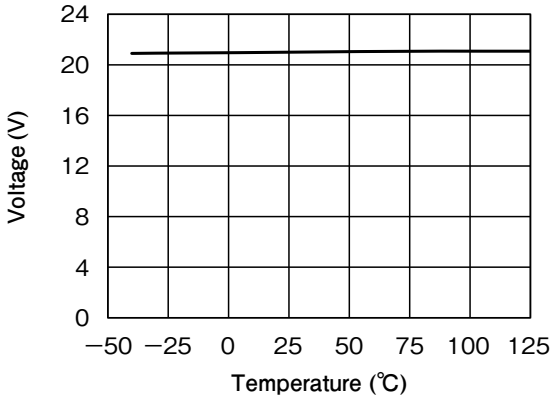
Source Current in Startup - Temperature



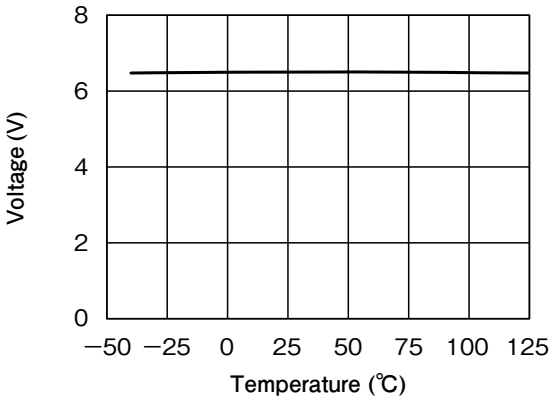
Source Current in Latch - Temperature



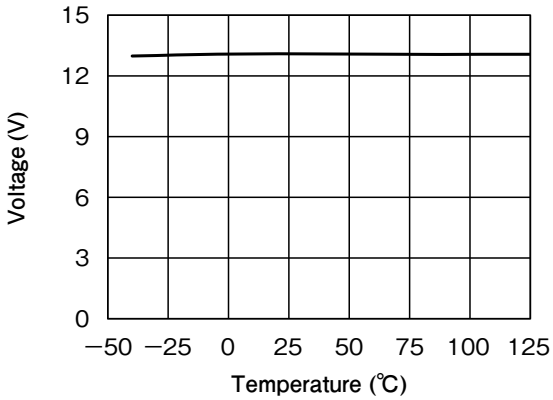
Operating Start Voltage - Temperature



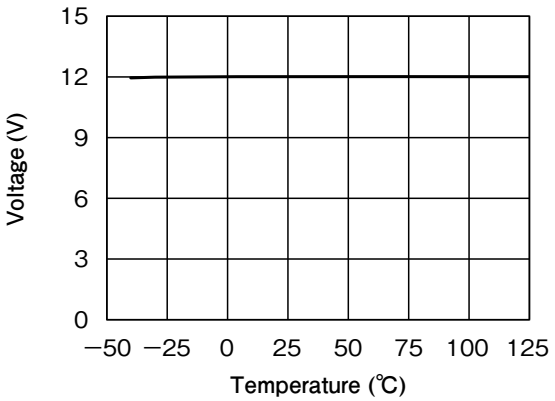
Operating Stop Voltage - Temperature



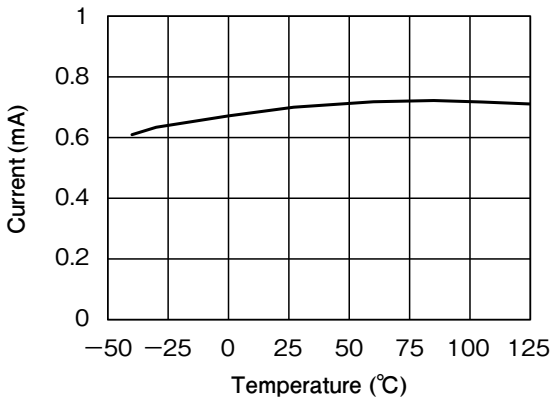
Upper Level Voltage in Latch - Temperature



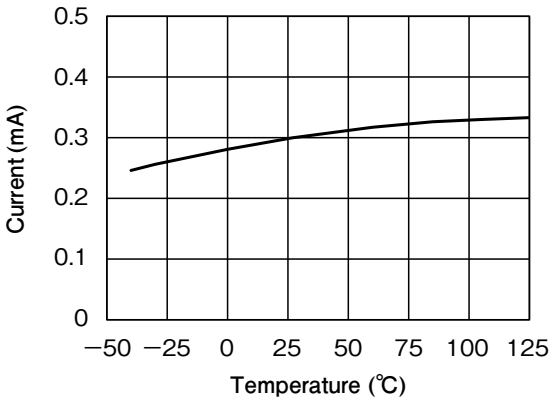
Lower Level Voltage in Latch - Temperature



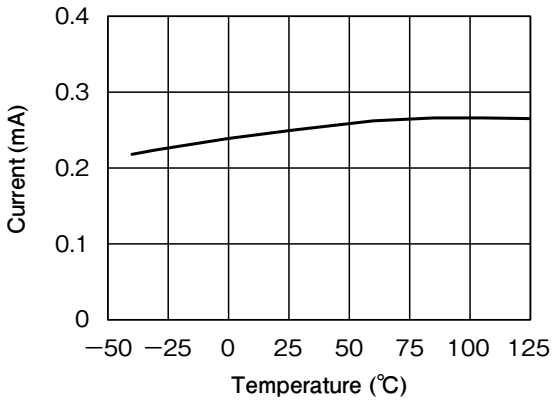
Supply Current 1 - Temperature



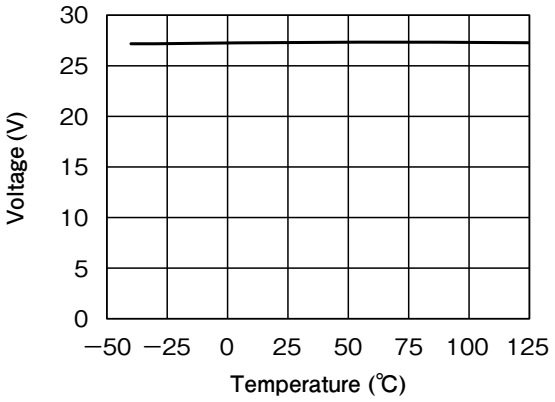
Supply Current 2 - Temperature



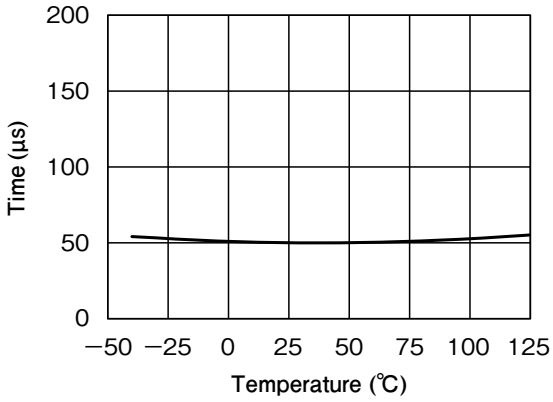
Supply Current in Latch - Temperature



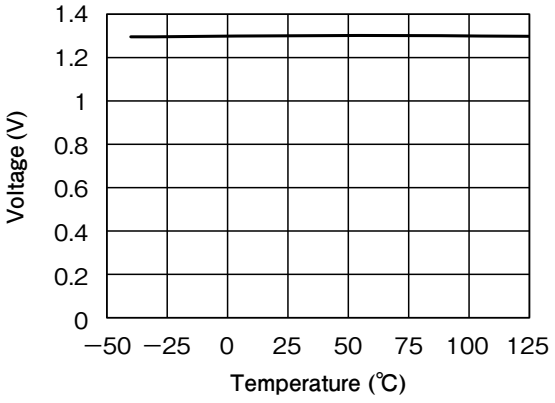
VDD Over Voltage Detection - Temperature



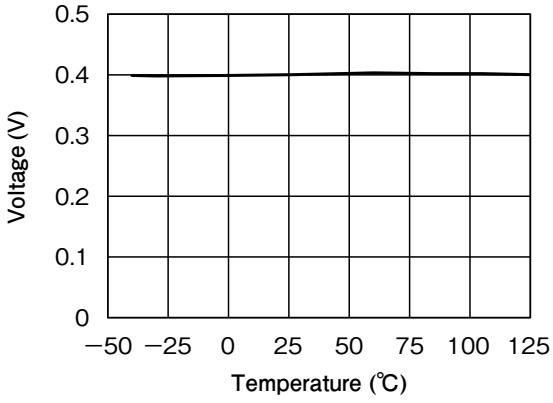
VDD Over Voltage Detection Delay Time - Temperature



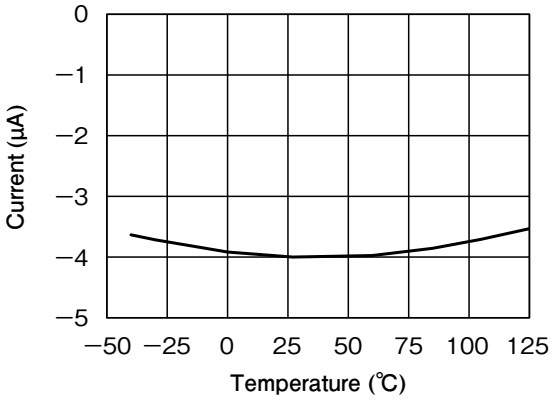
Frequency Switching Voltage - Temperature



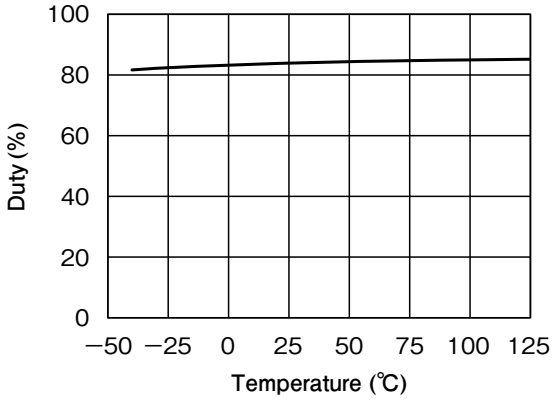
External Latch Stop Lebel - Temperature



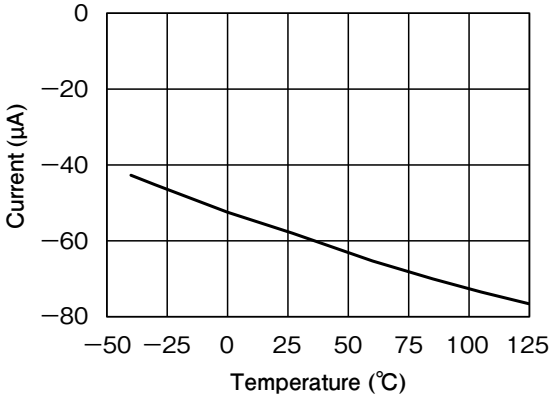
ADJ Source Current - Temperature



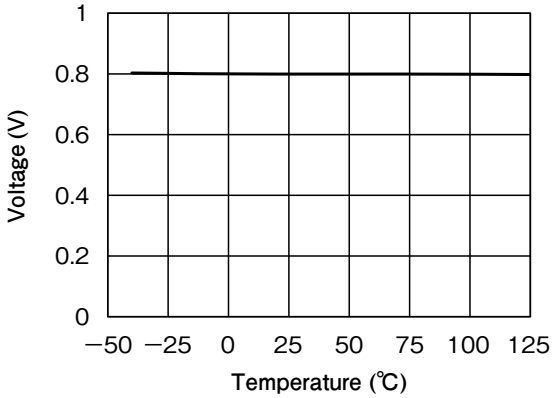
Maximum Duty Cycle - Temperature



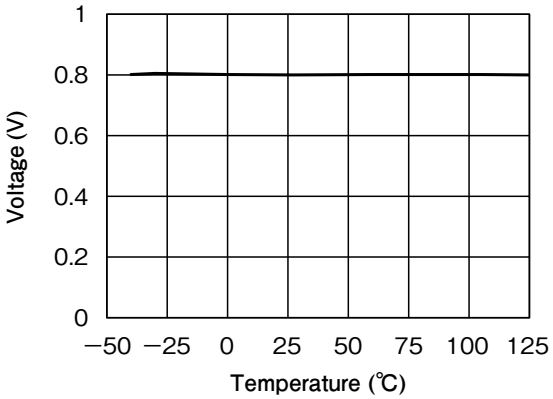
FB Source Current - Temperature



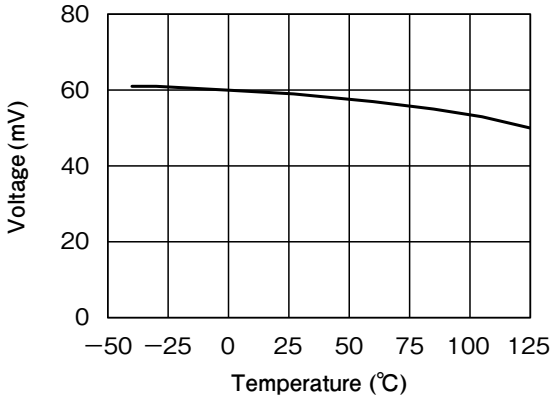
Gate Stop Voltage 1 - Temperature



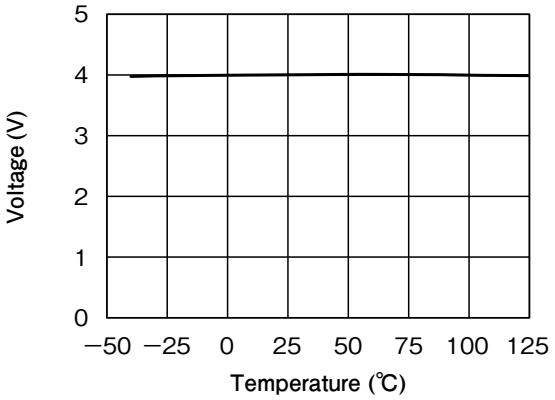
Gate Stop Voltage 2 - Temperature



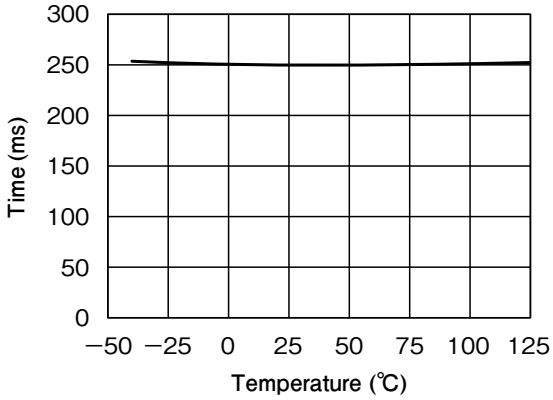
Gate Stop Voltage Hysteresis Range - Temperature



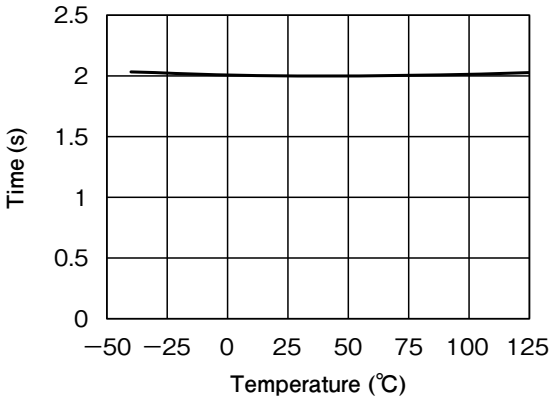
Over Load Detection Voltage - Temperature



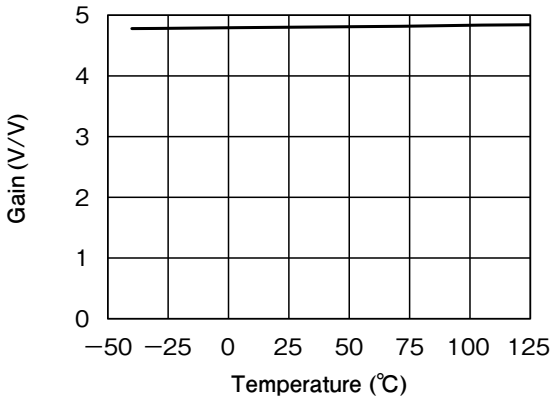
Over Load Timer - Temperature



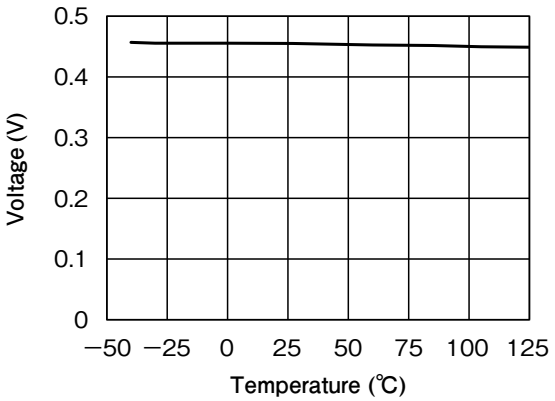
Restart Timer - Temperature



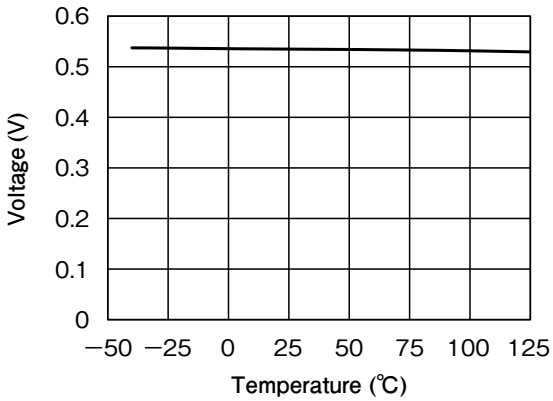
Voltage Gain - Temperature



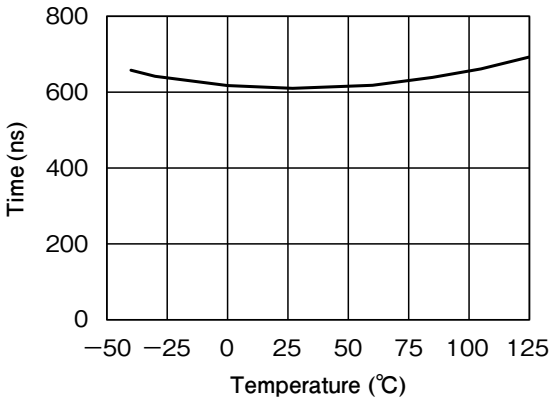
Over Current Detection Voltage 1 - Temperature



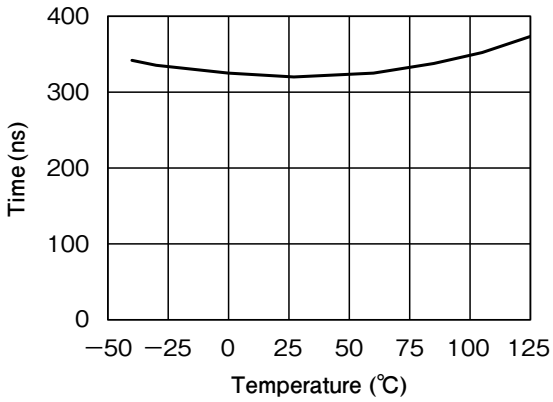
Over Current Detection Voltage 2 - Temperature



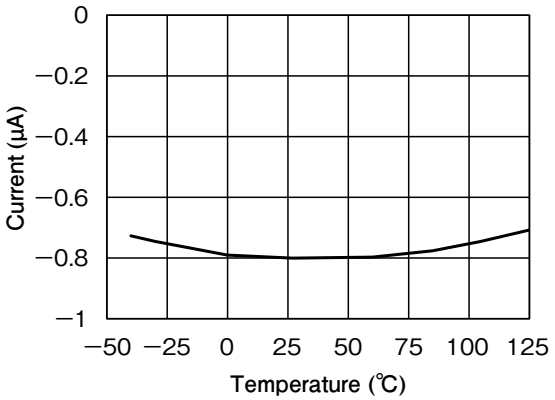
Minimum On Time 1 - Temperature



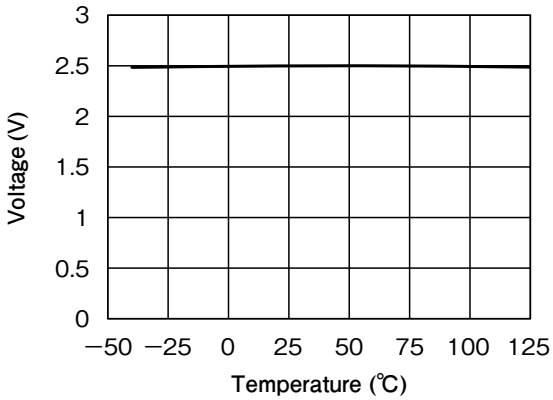
Minimum On Time 2 - Temperature



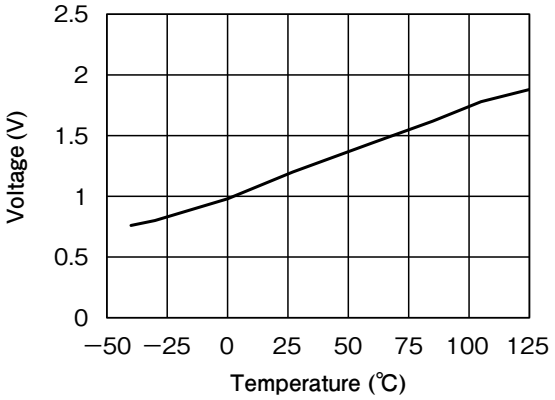
CS Source Current - Temperature



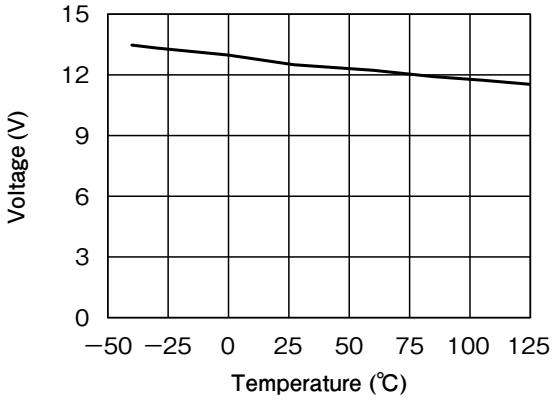
CS Latch Stop Detection Voltage - Temperature



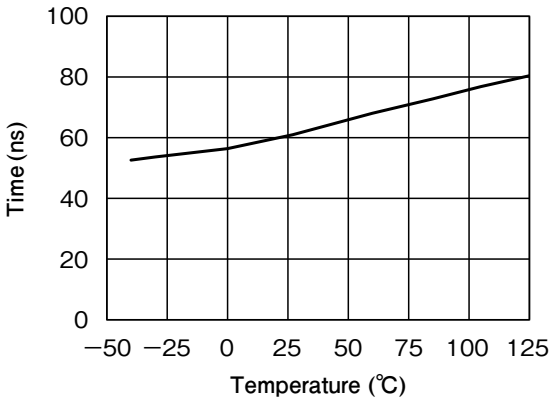
L Output Voltage - Temperature



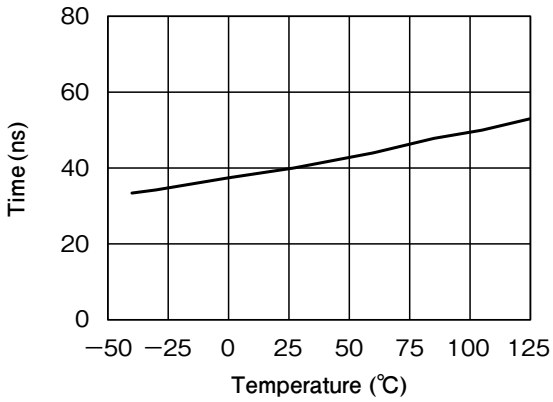
H Output Voltage - Temperature



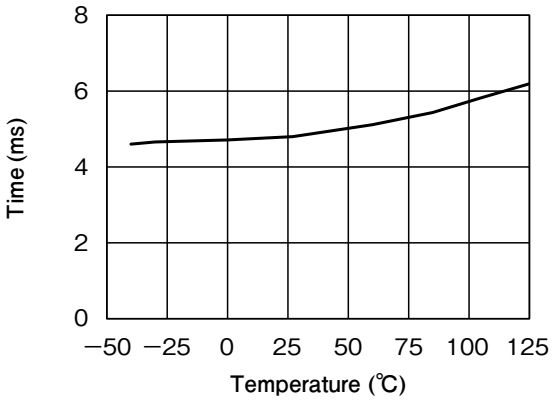
Rise Time - Temperature



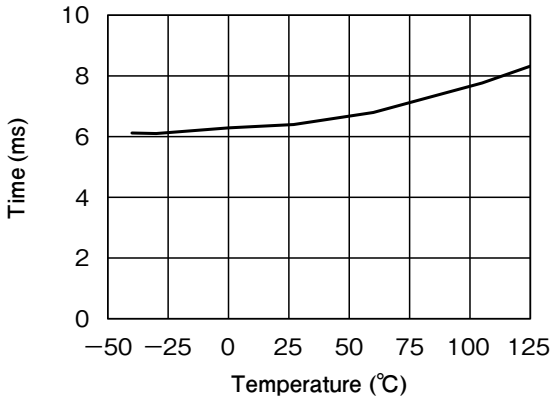
Fall Time - Temperature



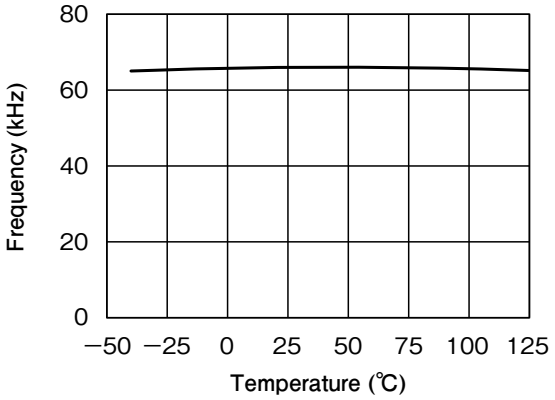
Soft Start Time 1 - Temperature



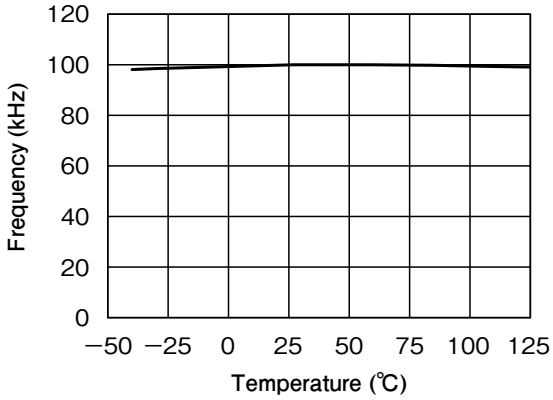
Soft Start Time 2 - Temperature



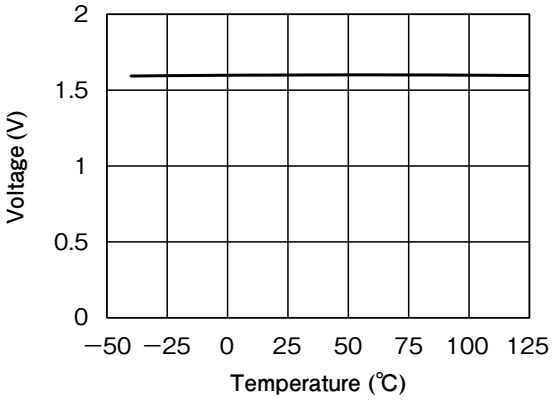
Maximum Frequency 1 - Temperature



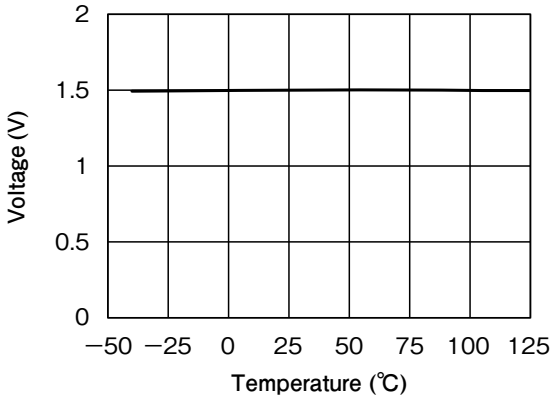
Maximum Frequency 2 - Temperature



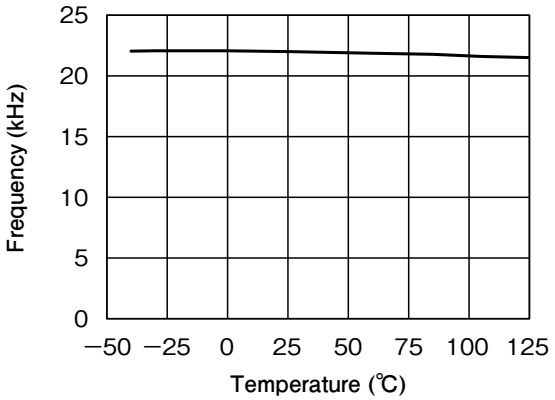
Frequency Decrease Biginning Voltage - Temperature



Frequency Increase Biginning Voltage - Temperature



Minimum Frequency 1 - Temperature



Minimum Frequency 2 - Temperature