SCM1100M Series Support for 3-shunt, Output Element : IGBT

■Features

- Each half-bridge circuit consists of a pre-driver circuit that is completely independent from the others
- Protection against simultaneous high- and low-side turning on
- Bootstrap diodes with series resistors for suppressing inrush current are incorporated
- CMOS compatible input (3.3 to 5 V)
- Designed to minimize simultaneous current through both high- and low-side IGBTs by optimizing gate drive resistors
- UVLO protection with auto restart
- Overcurrent protection with off-time period adjustable by an external capacitor
- Fault (FO indicator) signal output at protection activation: UVLO (low side only), OCP, and STP
- Proprietary power DIP package
- UL Recognized Component (File No.: E118037)

■Absolute Maximum Ratings

Parameter	Symbol	Ratings						Unit	Conditions
		SCM1101M (SCM1101MF)	SCM1103M	SCM1104M (SCM1104MF)	SCM1105MF	SCM1106M (SCM1106MF)	SCM1110MF		
Supply Voltage	V_{BB}	450	450	450	450	450	450	V	Between V_{BB} and LS1 to LS3
Supply Voltage (Surge)	$V_{DC(Surge)}$	500	500	500	500	500	500	V	Between V_{BB} and LS1 to LS3
IGBT Output Withstand Voltage	V_{CES}	600	600	600	600	600	600	V	V_{CC}=15V,I_C=1mA,V_{IN}=0V
Control Supply Voltage	V_{CC}	20	20	20	20	20	20	V	V_{CC}1 to 3 and COM1 to COM3
Control Supply Voltage (Bootstrap)	V_{BS}	20	20	20	20	20	20	V	V_{B1} to V_{B3} and HS (U,V,W)
Output Current (continuous)	Io	10	5	8	15	10	15	Adc	
Output Current (pulse)	Iop	20	10	16	30	20	30	Adc	T≤1ms
Input Voltage	V_{IN}	–0.5 to +7	–0.5 to +7	–0.5 to +7	–0.5 to +7	–0.5 to +7	–0.5 to +7	V	H_{IN1} to H_{IN3} or L_{IN1} to L_{IN3} and COM1 to COM3
FO Pin Voltage	V_{FO}	7	7	7	7	7	7	V	F_{O1} to F_{O3} and COM1 to COM3
Power Dissipation	P_D	20.8(33.8)	19	20.2(32.9)	41.7	20.8(33.8)	41.7	W	T_C=25°C while one IGBT element operates
Thermal Resistance (IGBT)	$R_{(j-c)Q}$	6(3.7)	6.3	6.2(3.8)	3	6(3.7)	3	°C/W	Per IGBT element
Thermal Resistance (FRD)	$R_{(j-c)F}$	6.5(4.2)	6.5	6.5(4.2)	4	6.5(4.2)	4	°C/W	Per FRD element
Operating Case Temperature	T_{OP}	–20 to +100	–20 to +100	–20 to +100	–20 to +100	–20 to +100	–20 to +100	°C	
Junction Temperature	Tj	150	150	150	150	150	150	°C	
Storage Temperature	Tstg	–40 to +150	–40 to +150	–40 to +150	–40 to +150	–40 to +150	–40 to +150	°C	
Insulation Withstand Voltage	Viso	2000	2000	2000	2000	2000	2000	V	Between rear and lead pins, AC one minute

■Recommended Operating Conditions

Parameter	Symbol	Ratings SCM1100M Series			Unit	Conditions
		min.	typ.	max.		
Main Supply Voltage	V_{DC}	–	300	400	V	Between V_{BB} and LS
Control Supply Voltage	V_{CC},V_{BS}	13.5	–	16.5	V	
Minimum Input Pulse Width	$t_{INmin(on)}$	0.5	–	–	μs	ON pulse
	$t_{INmin(off)}$	0.5	–	–	μs	OFF pulse
Input Signal Dead Time	t_{dead}	1.5	–	–	μs	
FO Pull-up Resistor	R_{FO}	1	–	22	kΩ	
CFO Capacitor Capacity	C_{FO}	1	–	10	nF	
FO Pull-up Voltage	V_{FO}	4.5	–	5.5	V	
Boot Capacitor	C_{BOOT}	10	–	220	uF	
Shunt Resistor*1	R_S	25.5	–	–	mΩ	For Ip≤rated output current (pulse)
PWM Carrier Frequency	fc	–	–	20*2	kHz	
Junction Temperature	Tj	–	–	125	°C	

*1: The shunt resistance varies depending on the rated current.

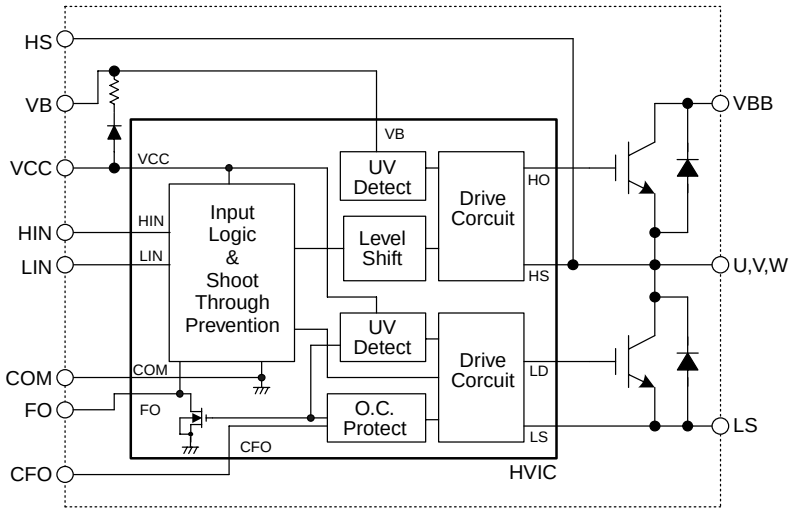
*2: 10 for SCM1101M(F)/SCM1015MF

■Electrical Characteristics

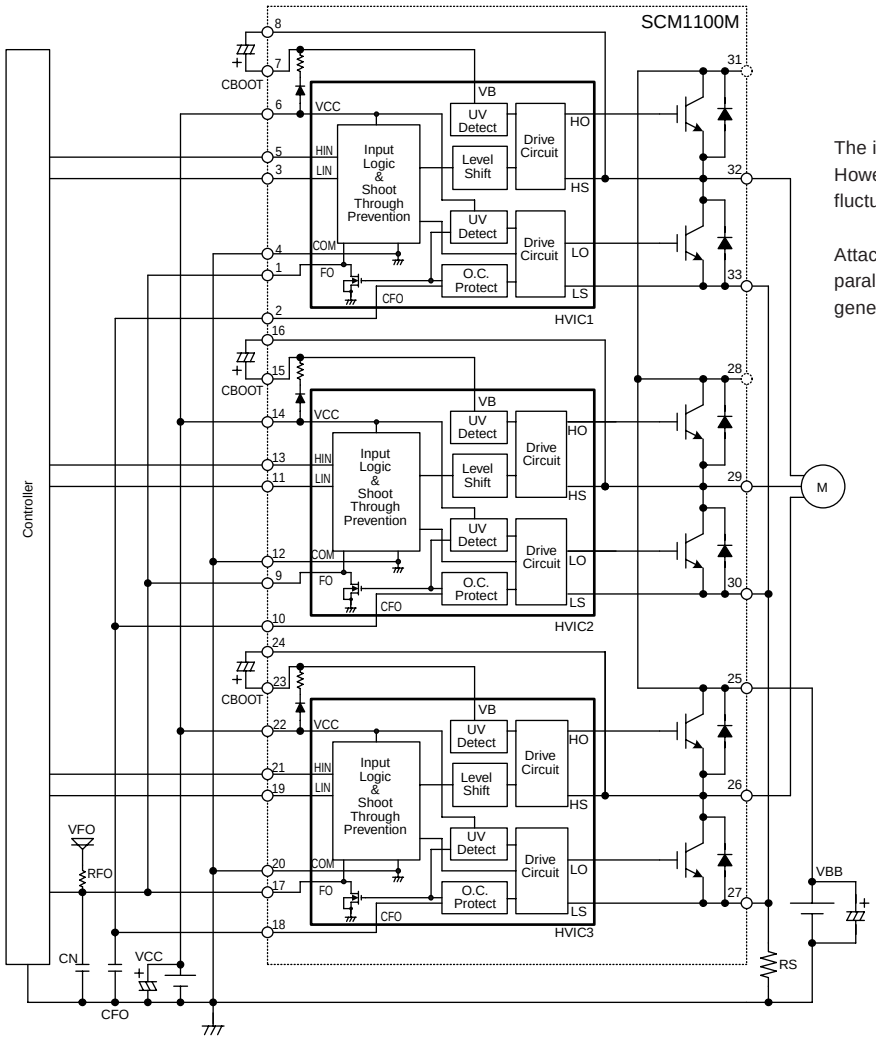
Parameter	Symbol	Ratings									Unit	Conditions
		SCM1101M/SCM1101MF			SCM1103M			SCM1104M/SCM1104MF				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
Control Supply Voltage	V_{CC}	13.5	–	16.5	13.5	–	16.5	13.5	–	16.5	V	Between V_{CC} and COM
Control Supply Current	I_{CC}	–	5	8	–	5	8	–	5	8	mA	V_{CC}=15V, 3 circuits total
Bootstrap Supply Current	I_{bs}	–	400	800	–	400	800	–	400	800	uA	V_B-HS=15V, 1 circuit
Input Voltage	V_{IH}	–	2	2.5	–	2	2.5	–	2	2.5	V	V_{CC}=15V, Output:ON
	V_{IL}	1	1.5	–	1	1.5	–	1	1.5	–		V_{CC}=15V, Output:OFF
Input Voltage Hysteresis Width	V_H	–	0.5	–	–	0.5	–	–	0.5	–		V_{CC}=15V
Input Current	I_{IH}	–	50	100	–	50	100	–	50	100	μA	V_{CC}=15V, V_{IN}=5V
	I_{IL}	–	–	2	–	–	2	–	–	2		V_{CC}=15V, V_{IN}=0V
Undervoltage Lock Out (high side)	V_{UVHL}	10	–	12	10	–	12	10	–	12	V	V_{CC}=15V
	V_{UVHH}	10.5	–	12.5	10.5	–	12.5	10.5	–	12.5		
Undervoltage Lock Out (low side)	V_{UVLL}	10.5	–	12.5	10.5	–	12.5	10.5	–	12.5		
	V_{UVLH}	11	–	13	11	–	13	11	–	13		
FO Pin Output Voltage	V_{FOL}	–	–	0.5	–	–	0.5	–	–	0.5	V	V_{CC}=15V,V_{FO}=5V
	V_{FOH}	4.8	–	–	4.8	–	–	4.8	–	–		R_{FO}=10kΩ
Overcurrent Protection Trip Voltage	V_{TRIP}	0.46	0.5	0.54	0.46	0.5	0.54	0.46	0.5	0.54	V	V_{CC}=15V
Overcurrent Protection Hold Time	t_P	2	–	–	2	–	–	2	–	–	ms	V_{CC}=15V, C_{FO}=2.2nF
Blanking Time	tbk	–	2	–	–	2	–	–	2	–	μs	V_{CC}=15V
IGBT Output Withstand Voltage	V_{CES}	600	–	–	600	–	–	600	–	–	V	V_{CC}=15V, I_C=1mA, V_{IN}=0V
IGBT Output Leakage Current	I_{CES}	–	–	1	–	–	1	–	–	1	mA	V_{CC}=15V, V_{CE}=600V, V_{IN}=0V
IGBT Output Saturation Voltage	$V_{CE(sat)}$	–	1.75	2.2	–	1.7	2.1	–	1.75	2.2	V	V_{CC}=15V, I_C=rated output current (continuous) V_{IN}=5V
Boot Diode Forward Voltage	V_F	–	1.7	2.2	–	1.4	2	–	1.6	2.2	V	V_{CC}=15V, I_F=rated output current (continuous), V_{IN}=0V
Boot Diode Leakage Current	I_{IB}	–	5	10	–	5	10	–	5	10	μA	V_R=600V
Boot Diode Forward Voltage	V_{FB}	–	1.1	1.3	–	1.1	1.3	–	1.1	1.3	V	I_F=0.15A
Boot Diode Recovery Time	trr	–	70	–	–	70	–	–	70	–	ns	I_F/I_{RP}=100mA/100mA
Boot Diode Series Resistance	R_B	17.6	22	26.4	17.6	22	26.4	17.6	22	26.4	Ω	
High Side Switching Time	td(on)	–	320	–	–	340	–	–	360	–	ns	V_{DC}=300V, V_{CC}=15V I_C=10A(SCM1101M), I_C=5A(SCM1103M), I_C=8A(SCM1104M) HIN=0 to 5V Inductive load
	tr	–	50	–	–	60	–	–	70	–		
	trr	–	80	–	–	80	–	–	80	–		
	td(off)	–	560	–	–	430	–	–	560	–		
	tf	–	210	–	–	240	–	–	210	–		
Low Side Switching Time	td(on)	–	350	–	–	380	–	–	420	–	ns	V_{DC}=300V, V_{CC}=15V I_C=10A(SCM1101M), I_C=5A(SCM1103M), I_C=8A(SCM1104M) HIN=0 to 5V Inductive load
	tr	–	80	–	–	90	–	–	110	–		
	trr	–	140	–	–	100	–	–	140	–		
	td(off)	–	610	–	–	500	–	–	630	–		
	tf	–	200	–	–	220	–	–	210	–		

Parameter	Symbol	Ratings									Unit	Conditions
		SCM1105MF			SCM1106M/SCM1106MF			SCM1110MF				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
Control Supply Voltage	V_{CC}	13.5	–	16.5	13.5	–	16.5	13.5	–	16.5	V	Between V_{CC} and COM
Control Supply Current	I_{CC}	–	5	8	–	5	8	–	5	8	mA	V_{CC}=15V, 3 circuits total
Bootstrap Supply Current	I_{bs}	–	400	800	–	400	800	–	400	800	uA	V_B-HS=15V, 1 circuit
Input Voltage	V_{IH}	–	2	2.5	–	2	2.5	–	2	2.5	V	V_{CC}=15V, Output:ON
	V_{IL}	1	1.5	–	1	1.5	–	1	1.5	–		V_{CC}=15V, Output:OFF
Input Voltage Hysteresis Width	V_H	–	0.5	–	–	0.5	–	–	0.5	–		V_{CC}=15V
Input Current	I_{IH}	–	50	100	–	50	100	–	50	100	μA	V_{CC}=15V, V_{IN}=5V
	I_{IL}	–	–	2	–	–	2	–	–	2		V_{CC}=15V, V_{IN}=0V
Undervoltage Lock Out (high side)	V_{UVHL}	10	–	12	10	–	12	10	–	12	V	V_{CC}=15V
	V_{UVHH}	10.5	–	12.5	10.5	–	12.5	10.5	–	12.5		
Undervoltage Lock Out (low side)	V_{UVLL}	10.5	–	12.5	10.5	–	12.5	10.5	–	12.5		
	V_{UVLH}	11	–	13	11	–	13	11	–	13		
FO Pin Output Voltage	V_{FOL}	–	–	0.5	–	–	0.5	–	–	0.5	V	V_{CC}=15V, V_{FO}=5V
	V_{FOH}	4.8	–	–	4.8	–	–	4.8	–	–		R_{FO}=10kΩ
Overcurrent Protection Trip Voltage	V_{TRIP}	0.46	0.5	0.54	0.46	0.5	0.54	0.46	0.5	0.54	V	V_{CC}=15V
Overcurrent Protection Hold Time	t_P	2	–	–	2	–	–	2	–	–	ms	V_{CC}=15V,C_{FO}=2.2nF
Blanking Time	tbk	–	2	–	–	2	–	–	2	–	μs	V_{CC}=15V
IGBT Output Withstand Voltage	V_{CES}	600	–	–	600	–	–	600	–	–	V	V_{CC}=15V, I_C=1mA, V_{IN}=0V
IGBT Output Leakage Current	I_{CES}	–	–	1	–	–	1	–	–	1	mA	V_{CC}=15V, V_{CE}=600V, V_{IN}=0V
IGBT Output Saturation Voltage	$V_{CE(sat)}$	–	1.75	2.2	–	2.2	2.6	–	2.2	2.6	V	V_{CC}=15V, I_C=rated output current (continuous) V_{IN}=5V
Boot Diode Forward Voltage	V_F	–	1.75	2.2	–	1.7	2.2	–	1.75	2.2	V	V_{CC}=15V, I_F=rated output current (continuous), V_{IN}=0V
Boot Diode Leakage Current	I_{IB}	–	5	10	–	5	10	–	5	10	μA	V_R=600V
Boot Diode Forward Voltage	V_{FB}	–	1.1	1.3	–	1.1	1.3	–	1.1	1.3	V	I_F=0.15A
Boot Diode Recovery Time	trr	–	70	–	–	70	–	–	70	–	ns	I_F/I_{RP}=100mA/100mA
Boot Diode Series Resistance	R_B	17.6	22	26.4	17.6	22	26.4	17.6	22	26.4	Ω	
High Side Switching Time	td(on)	–	365	–	–	320	–	–	365	–	ns	V_{DC}=300V, V_{CC}=15V I_C=15A(SCM1105M), I_C=10A(SCM1106M), I_C=15A(SCM1110MF) HIN=0 to 5V Inductive load
	tr	–	80	–	–	50	–	–	80	–		
	trr	–	90	–	–	80	–	–	90	–		
	td(off)	–	690	–	–	490	–	–	650	–		
	tf	–	200	–	–	80	–	–	85	–		
Low Side Switching Time	td(on)	–	415	–	–	350	–	–	415	–	ns	V_{DC}=300V, V_{CC}=15V I_C=15A(SCM1105M), I_C=10A(SCM1106M), I_C=15A(SCM1110MF) HIN=0 to 5V Inductive load
	tr	–	135	–	–	80	–	–	135	–		
	trr	–	115	–	–	140	–	–	115	–		
	td(off)	–	790	–	–	540	–	–	755	–		
	tf	–	205	–	–	80	–	–	85	–		

■Internal Block Diagram (Single Circuit)



■Typical Connection Diagram

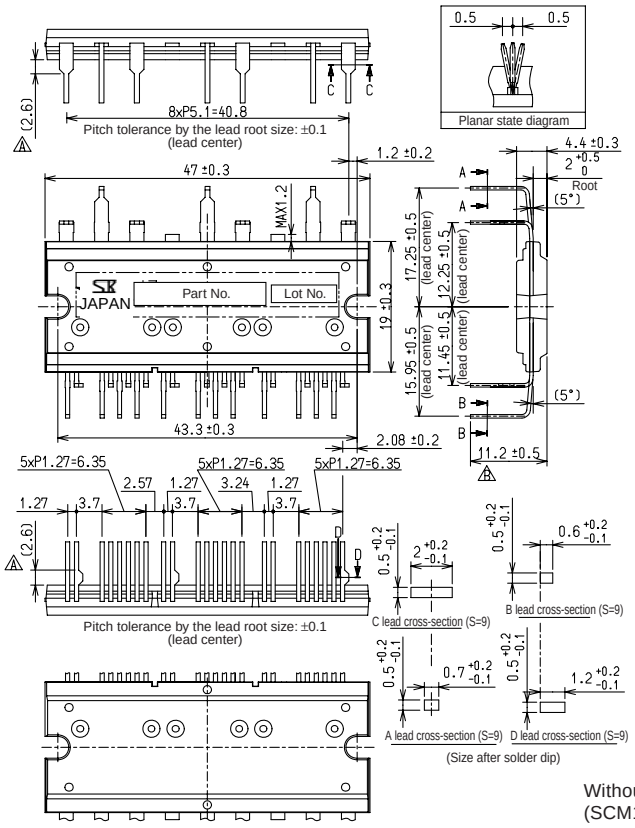


The input pulldown resistor is built in IC (about 100 kΩ). However, if the input is expected to be unstable or very fluctuant, it needs to be reinforced with external resistor.

Attach capacitors near IC. Attach a ceramic capacitor in parallel with the electrolytic capacitor if too much noise is generated.

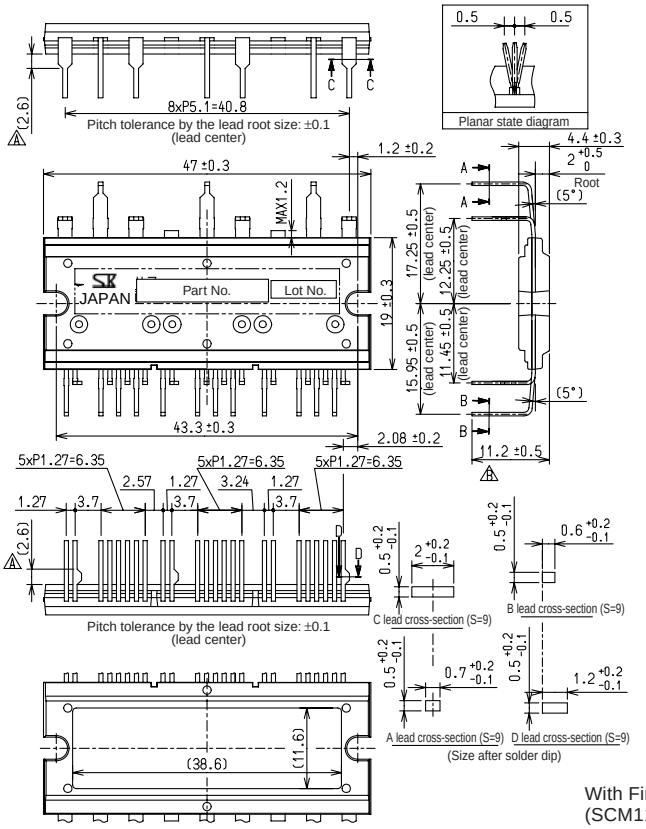
■External Dimensions (SCM)

(Unit : mm)



Without Fin
(SCM1100M)

Forming No. 2551
Product Mass: Approx. 12.6g



With Fin
(SCM1100MF)

Forming No. 2552
Product Mass: Approx. 13.5g