

SCM1100M Series IGBT Output Element, Built-in Shoot Through Prevention and Overcurrent Protection Circuits

■ 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

(T_a=25°C)

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 _{CC1} 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)	I _o	10	5	8	15	10	15	A	
Output Current (pulse)	I _{op}	20	10	16	30	20	30	A	T _s ≤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	FO1 to FO3 and COM1 to COM3
Power Dissipation	P _D	20.8(33.7)	19.8	20.1(32.8)	41.6	20.8(33.7)	41.6	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	T _J	150	150	150	150	150	150	°C	
Storage Temperature	T _{stg}	-40 to +150	-40 to +150	-40 to +150	-40 to +150	-40 to +150	-40 to +150	°C	
Insulation Withstand Voltage	V _{iso}	2000	2000	2000	2000	2000	2000	V	Between rear and lead pins, AC one minute

■ Recommended Operating Conditions

Parameter	Symbol	Ratings			Unit	Conditions
		SCM1100M Series				
		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}	1.0	–	–	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	μF	
PWM Carrier Frequency	f _c	–	–	20	kHz	For the SCM1101M (F) and SCM1105MF: 10
Junction Temperature	T _J	–	–	125	°C	

Electrical Characteristics

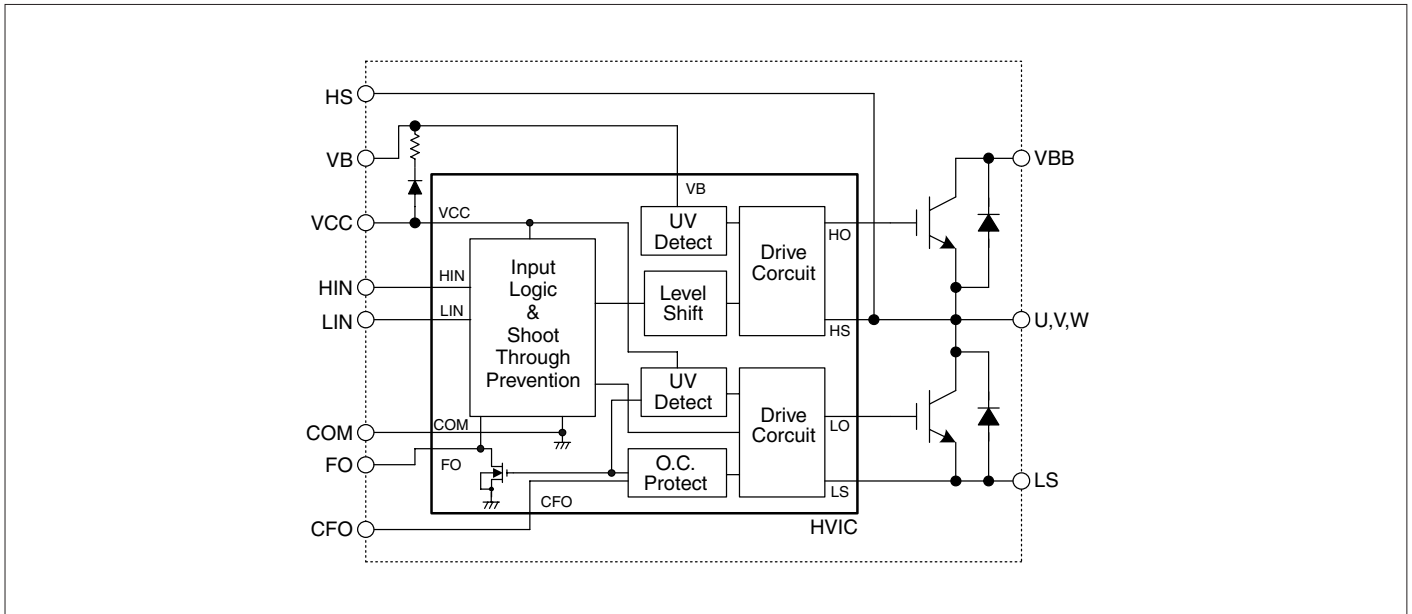
(T_a=25°C)

Parameter	Symbol	Ratings									Unit	Conditions
		SCM1101M/SCM1101MF			SCM1103M			SCM1104M/SCM1104MF				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
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	µA	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	–	µA	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	V _{CC} =15V
	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 R _{FO} =10kΩ
	V _{FOH}	4.8	–	–	4.8	–	–	4.8	–	–		
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	t _{bk}	–	2	–	–	2	–	–	2	–	µs	V _{CC} =15V
IGBT Output Breakdown 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 _B	–	–	10	–	–	10	–	–	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	t _{rr}	–	70	–	–	70	–	–	70	–	ns	I _F /I _{RP} =100mA/100mA
Boot Diode Series Resistance	R _B	–	22	–	–	22	–	–	22	–	Ω	
High Side Switching Time	td(on)	–	320	–	–	340	–	–	360	–	ns	V _{DC} =300V, V _{CC} =15V I _C =Rating of Output Current (Continuous) H _{IN} =0 to 5V Inductive load
	t _r	–	50	–	–	60	–	–	70	–		
	t _{rr}	–	80	–	–	80	–	–	80	–		
	td(off)	–	560	–	–	430	–	–	560	–		
	t _f	–	210	–	–	240	–	–	210	–		
Low Side Switching Time	td(on)	–	350	–	–	380	–	–	420	–	ns	V _{DC} =300V, V _{CC} =15V I _C =Rating of Output Current (Continuous) H _{IN} =0 to 5V Inductive load
	t _r	–	80	–	–	90	–	–	110	–		
	t _{rr}	–	140	–	–	100	–	–	140	–		
	td(off)	–	610	–	–	500	–	–	630	–		
	t _f	–	200	–	–	220	–	–	210	–		

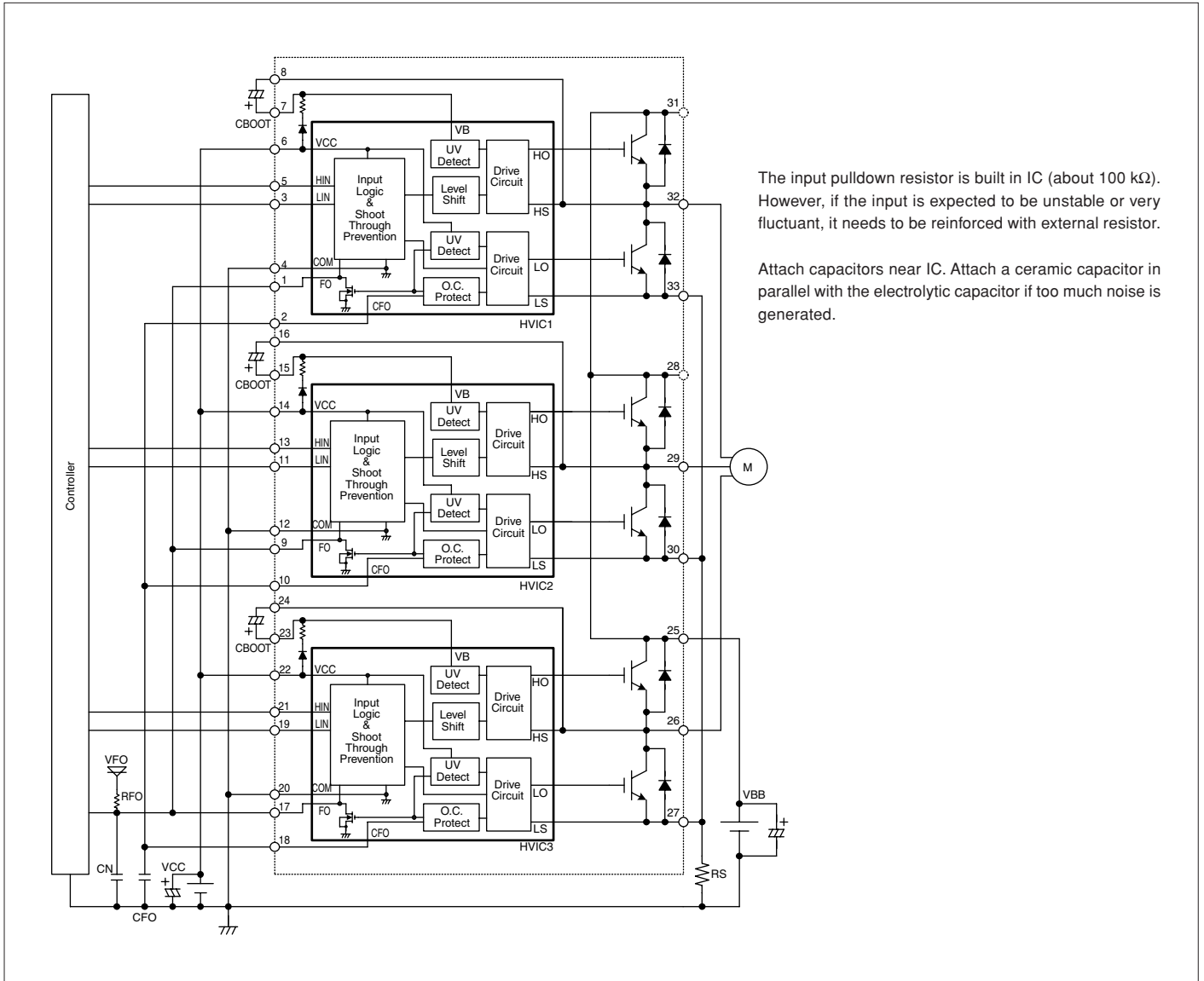
(T_a=25°C)

Parameter	Symbol	Ratings									Unit	Conditions
		SCM1105MF			SCM1106M/SCM1106MF			SCM1110MF				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
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	µA	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	–	µA	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	V _{CC} =15V
	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 R _{FO} =10kΩ
	V _{FOH}	4.8	–	–	4.8	–	–	4.8	–	–		
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	t _{bk}	–	2	–	–	2	–	–	2	–	µs	V _{CC} =15V
IGBT Output Breakdown 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 _B	–	–	10	–	–	10	–	–	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	t _{rr}	–	70	–	–	70	–	–	70	–	ns	I _F /I _{RP} =100mA/100mA
Boot Diode Series Resistance	R _B	–	22	–	–	22	–	–	22	–	Ω	
High Side Switching Time	td(on)	–	365	–	–	320	–	–	365	–	ns	V _{DC} =300V, V _{CC} =15V I _C =Rating of Output Current (Continuous) H _{IN} =0 to 5V Inductive load
	t _r	–	80	–	–	50	–	–	80	–		
	t _{rr}	–	90	–	–	80	–	–	90	–		
	td(off)	–	690	–	–	490	–	–	650	–		
	t _f	–	200	–	–	80	–	–	85	–		
Low Side Switching Time	td(on)	–	415	–	–	350	–	–	415	–	ns	V _{DC} =300V, V _{CC} =15V I _C =Rating of Output Current (Continuous) H _{IN} =0 to 5V Inductive load
	t _r	–	135	–	–	80	–	–	135	–		
	t _{rr}	–	115	–	–	140	–	–	115	–		
	td(off)	–	790	–	–	540	–	–	755	–		
	t _f	–	205	–	–	80	–	–	85	–		

Internal Block Diagram (One of three phases)



Typical Connection Diagram

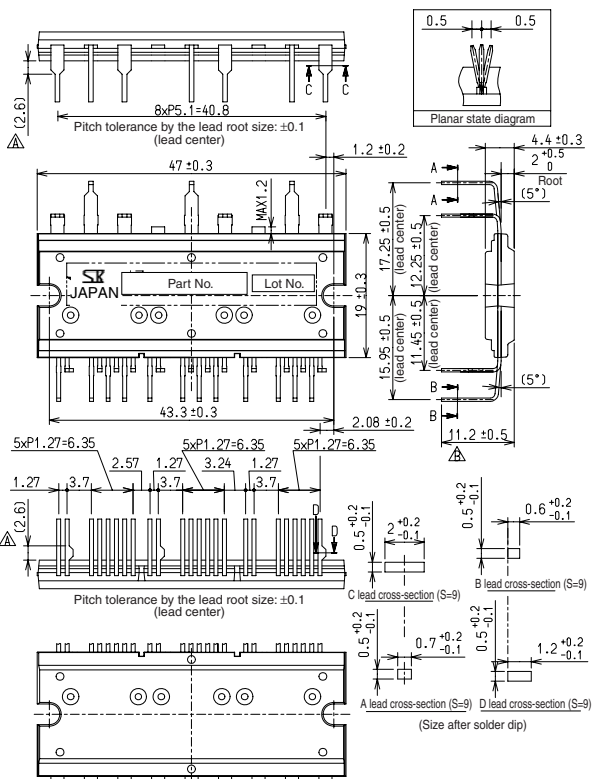


The input pulldown resistor is built in IC (about 100 kΩ). However, if the input is expected to be unstable or very fluctuant, it needs to be reinforced with external resistor.

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

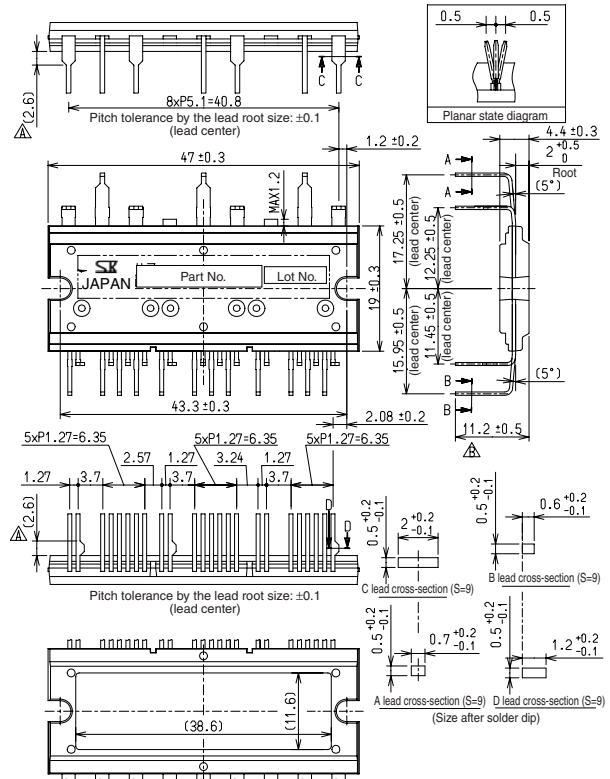
External Dimensions (SCM)

(Unit : mm)



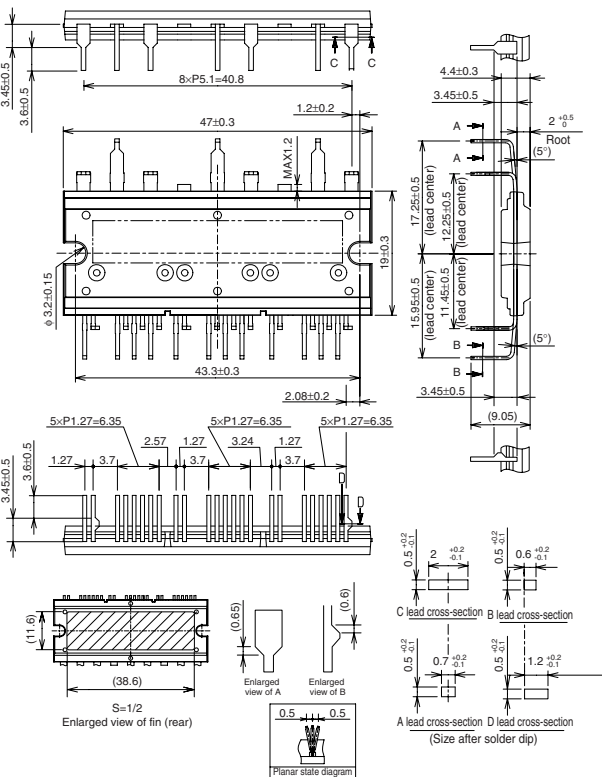
Without Fin
(SCM1100M)

Forming No. 2551
Product Mass: Approx. 12.6g



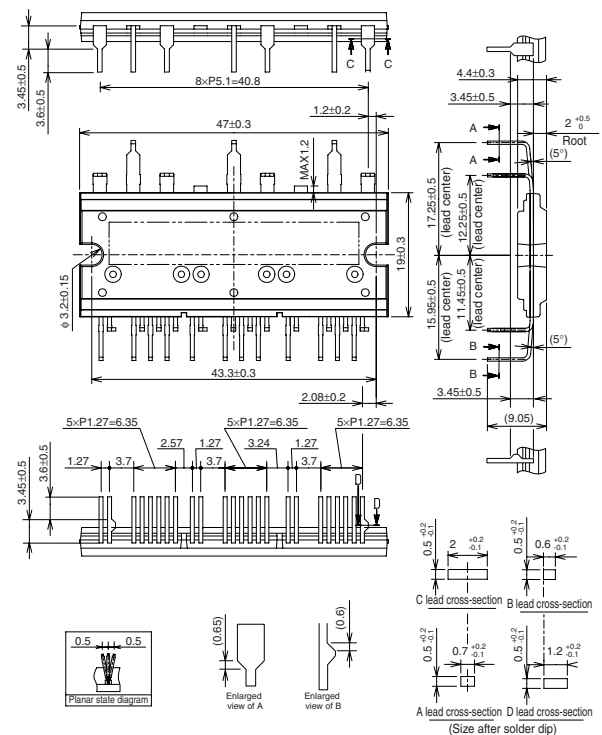
With Fin
(SCM1100MF)

Forming No. 2552
Product Mass: Approx. 13.5g



With Fin
(SCM1100M)

Forming No. 2554
Product Mass: Approx. 13.5g



Without Fin
(SCM1100MF)

Forming No. 2556
Product Mass: Approx. 12.6g