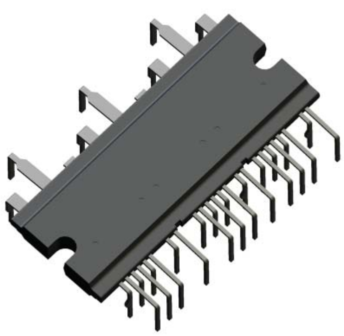
SCM1104M

High Voltage 3 Phase Motor Driver

Features and Benefits

- 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

Package: Power DIP



Not to scale

Description

The SCM1104M inverter power module (IPM) device provides a robust, highly-integrated solution for optimally controlling 3-phase motor power inverter systems and variable speed control systems used in energy-conserving designs to drive motors of residential and commercial appliances. These ICs take 85 to 253 VAC input voltage, and 10 A (continuous) output current. They can withstand voltages of up to 600 V (IGBT breakdown voltage).

The SCM1100M series employs a new, small-footprint proprietary DIP package. The IC itself consists of all of the necessary power elements (six IGBTs), pre-drive ICs (three), and flyback diodes (six), needed to configure the main circuit of an inverter, as well as a bootstrap circuit (three bootstrap diodes and three boot resistors) as a high-side drive power supply. This enables the main circuit of the inverter to be configured with fewer external components than traditional designs.

Applications include residential white goods (home appliances) and commercial appliance motor control, such as:

- Air conditioner fan motor
- Refrigerator compressor motor
- Washing machine main motor
- Air conditioner compressor motor

Functional Block Diagram

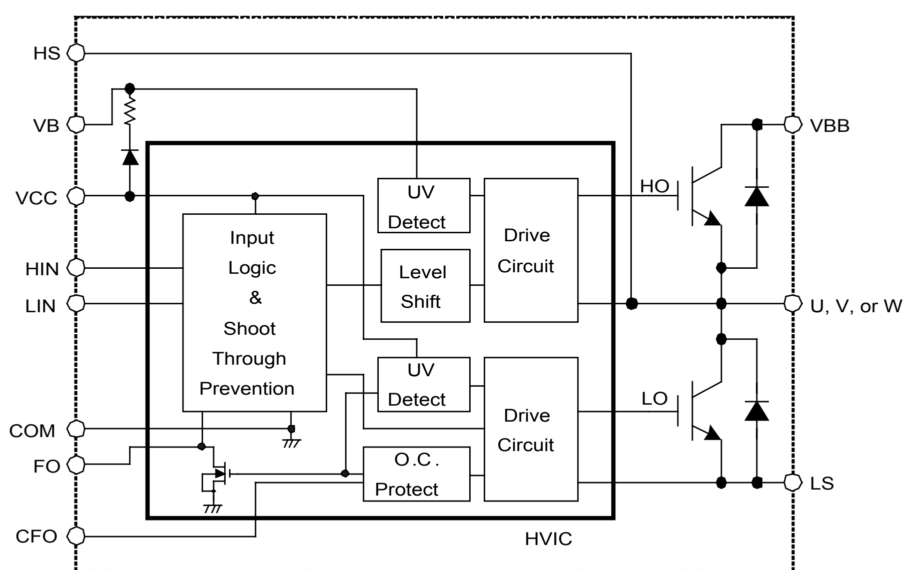


Figure 1. Diagram of one of three phases in the device.

Selection Guide

Part Number	Packing	IGBT Breakdown Voltage, V_{CES}(min) (V)	IGBT Saturation Voltage, $V_{CE(sat)}$(typ) (V)	Output Current	
				Continuous, I_O(max) (A)	Pulsed, I_{OP} (max) (A)
SCM1104M	10 pieces per tube	600	1.75	8	16

Absolute Maximum Ratings, valid at T_A = 25°C

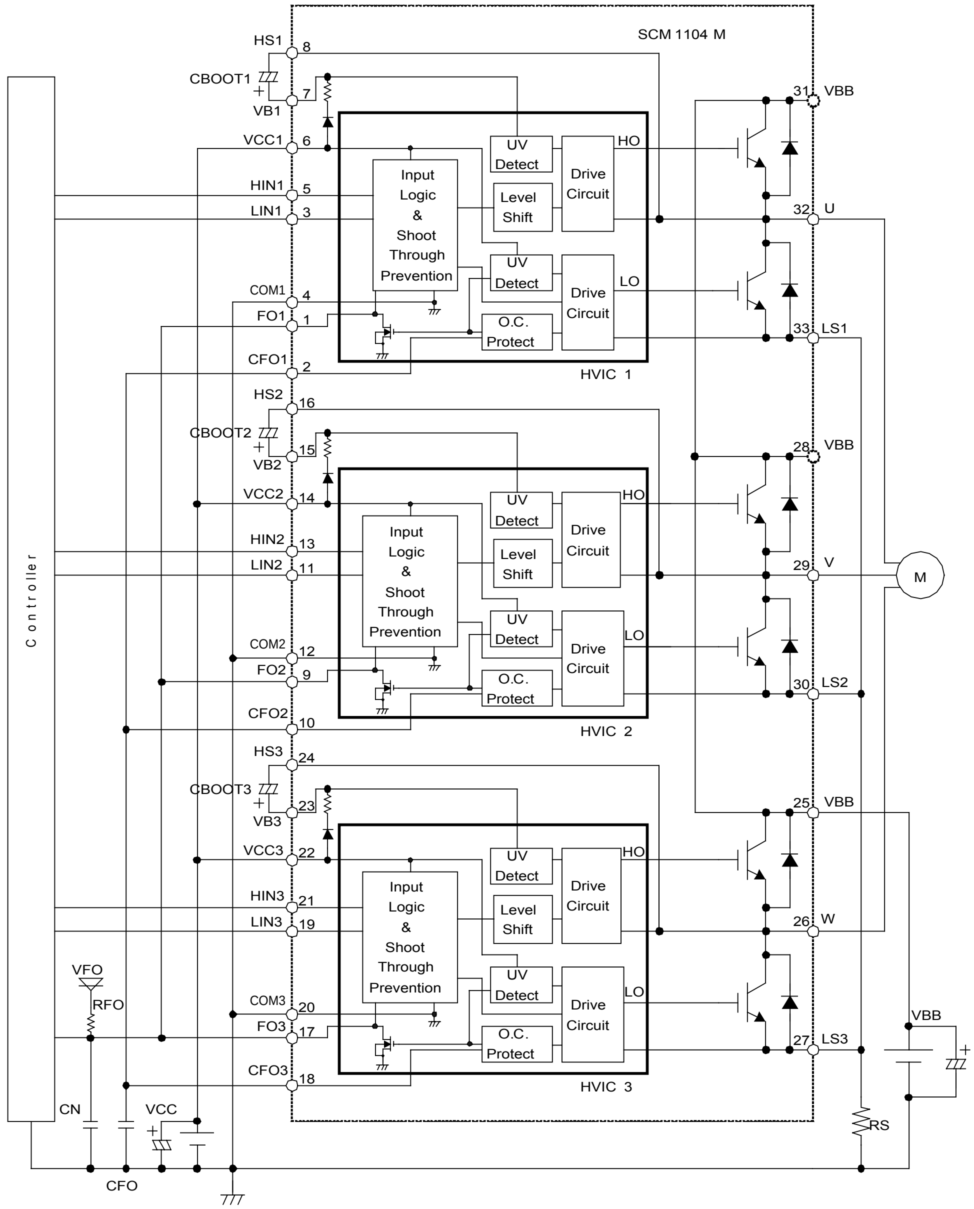
Characteristic	Symbol	Remarks	Rating	Units
IGBT Breakdown Voltage	V_{CES}	V_{CC} = 15 V, I_C = 1 mA, V_{IN} = 0 V	600	V
Logic Supply Voltage	V_{CC}	Between VCC and COM	20	V
Boot-strap Voltage	V_{BS}	Between VB and HS (U,V,W)	20	V
Output Current, Continuous	I_O	T_{Case} = 25°C	8	A
Output Current, Pulsed	I_{OP}	Pulse Width ≤ 100 μs	16	A
Input Voltage	V_{IN}		–0.5 to 7	V
FO Terminal Voltage	V_{FO}	Between FO and COM	7	V
Maximum Allowable Power Dissipation	P_D	T_{Case} = 25°C, 1 element operation (IGBT)	19	W
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1 element operation (IGBT)	6.4	°C/W
		1 element operation (FWD)	6.6	°C/W
Case Operating Temperature	T_{OPC}		–20 to 100	°C
Junction Temperature (IGBT)	T_J		150	°C
Storage Temperature	T_{stg}		–40 to 150	°C
Isolation Voltage	V_{iso}	Between exposed tab region and each pin; 1 minute, ac	1500	V_{rms}

Recommended Operating Conditions

Characteristic	Symbol	Remarks	Min.	Typ.	Max.	Units
Main Supply Voltage	V_{BB}	Between VBB and LS	–	300	450	V
Logic Supply Voltage	V_{CC}	Between VCC and COM	13.5	–	16.5	V
Logic Supply Voltage	V_{BS}	Between VB and HS	13.5	–	16.5	V
Minimum Input Pulse Width	$t_{INmin(on)}$		0.5	–	–	μs
	$t_{INmin(off)}$		0.5	–	–	μs
Dead Time	t_{dead}		1.5	–	–	μs
Junction Temperature	T_J		–	–	125	°C

All performance characteristics given are typical values for circuit or system baseline design only and are at the nominal operating voltage and an ambient temperature, T_A, of 25°C, unless otherwise stated.

Typical Application Diagram



NOTE:

- All of the input pins are connected to GND with internal pull-down resistors rated at 100 kΩ, however, an external pull-down resistor may be required to secure stable condition of the inputs if high impedance conditions are applied to them.
- To use the OCP circuit, an external shunt resistor, RS, is needed. The RS value can be obtained from the formula:

$$R_S(\Omega) = 0.5\ \text{V} / \text{Overcurrent Detection Set Current (A)} - 0.009.$$

- A blanking timer is built-in to mask the noise generated on RS at turn-on.
- The external electrolytic capacitors should be placed as close to the IC as possible, in order to avoid malfunctions from external noise interference. Put a ceramic capacitor in parallel with the electrolytic capacitor if further reduction of noise susceptibility is necessary.

ELECTRICAL CHARACTERISTICS, valid at T_A=25°C, unless otherwise noted

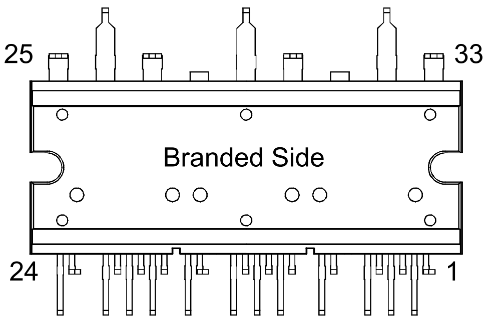
Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Logic Supply Voltage	V_{CC}	Between VCC and COM	13.5	–	16.5	V
Logic Supply Current	I_{CC}	V_{CC} = 15 V, 3 phases operating	–	5	8	mA
Input Voltage	V_{IH}	V_{CC} = 15 V, output on	–	2.0	2.5	V
	V_{IL}	V_{CC} = 15 V, output off	1.0	1.5	–	V
Input Voltage Hysteresis	V_{Ihys}	V_{CC} = 15 V	–	0.5	–	V
Input Current	I_{IHH}	V_{CC} = 15 V, V_{IN} = 5 V	–	50	100	μA
	I_{ILH}	V_{CC} = 15 V, V_{IN} = 0 V	–	–	2	μA
Undervoltage Lock Out (High Side)	U_{VHL}	V_{CC} = 15 V	10.0	–	12.0	V
	U_{VHH}		10.5	–	12.5	V
Undervoltage Lock Out (Low Side)	U_{VLL}	V_{CC} = 15 V	10.5	–	12.5	V
	U_{VLH}		11.0	–	13.0	V
FO Terminal Output Voltage	V_{FOL}	V_{CC} = 15 V, V_{FO} = 5 V, R_F=10 kΩ	–	–	0.5	V
	V_{FOH}		4.8	–	–	V
Overcurrent Protection Trip Voltage	V_{TRIP}	V_{CC} = 15 V	0.46	0.50	0.54	V
Overcurrent Protection Hold Time	t_p	V_{CC} = 15 V, C_{FO} = 0.022 μF	2	–	–	ms
Blanking Time	t_{blank}	V_{CC} = 15 V	–	2	–	μs
IGBT Breakdown Voltage	V_{CES}	V_{CC} = 15 V, I_C = 250 μA, V_{IN} = 0 V	600	–	–	V
IGBT Leakage Current	I_{CES}	V_{CC} = 15 V, V_{CE} = 600 V, V_{IN} = 0 V	–	–	1	mA
IGBT Saturation Voltage	$V_{CE(sat)}$	V_{CC} = 15 V, I_C = 8 A, V_{IN} = 5 V	–	1.75	2.2	V
Diode Forward Voltage	V_F	V_{CC} = 15 V, I_F = 8 A, V_{IN} = 0 V	–	1.6	2.2	V
Diode Recovery Time	t_{rr}	I_F = 8 A, di/dt = 100 A/μs	–	50	–	ns
Diode Leakage Current (Boot Strap)	I_{Lb}	V_R = 600 V	–	5	10	μA
Diode Forward Voltage (Boot Strap)	V_{Fb}	I_F = 0.15 A	–	1.1	1.3	V
Diode Series Resistor (Boot Strap)	R_b		17.6	22.0	26.4	Ω
High Side Switching Time	$t_{dH(on)}$	V_{BB} = 280 V, V_{CC} = 15V, I_C = 8 A, inductive load; V_{IN} 0→5 V or 5→0 V	–	0.25	–	μs
	t_{rH}		–	0.1	–	μs
	$t_{dH(off)}$		–	0.25	–	μs
	t_{fH}		–	0.3	–	μs
Low Side Switching Time	$t_{dL(on)}$		–	0.3	–	μs
	t_{rL}		–	0.1	–	μs
	$t_{dL(off)}$		–	0.3	–	μs
	t_{fL}		–	0.3	–	μs

Input Output Truth Table

HIN	LIN	OUT
L	L	High Z
L	H	L
H	L	H
H	H	High Z

High Z = High Impedence

Pin-out Diagram



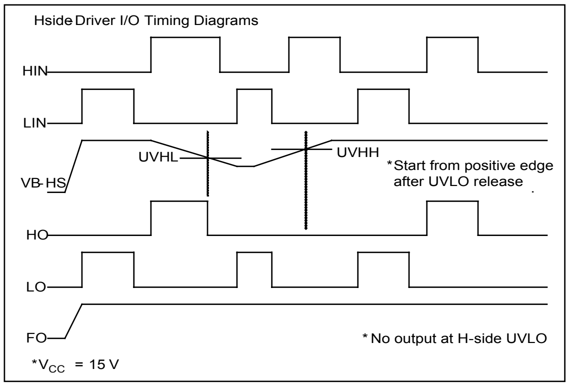
(Pins Upward View)

Terminal List Table

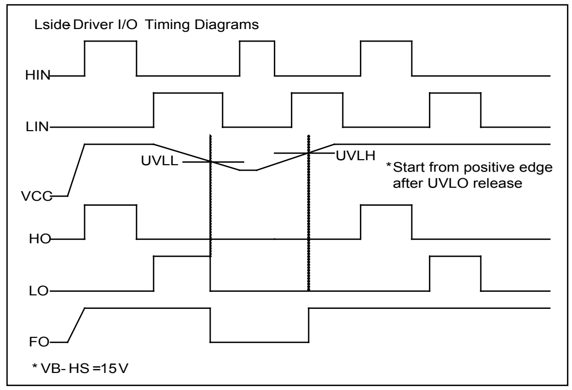
Name	Number	Function
1	FO1	U phase fault output for overcurrent and UVLO detected
2	CFO1	Capacitor for U phase overcurrent protection hold time
3	LIN1	Signal input for low-side U phase (active high)
4	COM1	Supply ground for U phase IC
5	HIN1	Signal input for high-side U phase (active high)
6	VCC1	Supply voltage for U phase IC
7	VB1	High-side floating supply voltage for U phase
8	HS1	High-side floating supply ground for U phase
9	FO2	V phase fault output for overcurrent and UVLO detected
10	CFO2	Capacitor for V phase overcurrent protection hold time
11	LIN2	Signal input for low-side V phase (active high)
12	COM2	Supply ground for V phase IC
13	HIN2	Signal input for high-side V phase (active high)
14	VCC2	Supply voltage for V phase IC
15	VB2	High-side floating supply voltage for V phase
16	HS2	High-side floating supply ground for V phase
17	FO3	W phase fault output for overcurrent and UVLO detected
18	CFO3	Capacitor for W phase overcurrent protection hold time
19	LIN3	Signal input for low-side W phase (active high)
20	COM3	Supply ground for W phase IC
21	HIN3	Signal input for high-side W phase (active high)
22	VCC3	Supply voltage for W phase IC
23	VB3	High-side floating supply voltage for W phase
24	HS3	High-side floating supply ground for W phase
25	VBB	Positive dc bus supply voltage
26	W	Output for W phase
27	LS3	Negative dc bus supply ground for W phase
28	VBB	Cut-pin (positive dc bus supply voltage)
29	V	Output for V phase
30	LS2	Negative dc bus supply ground for V phase
31	VBB	Cut-pin (positive dc bus supply voltage)
32	U	Output for U phase
33	LS1	Negative dc bus supply ground for U phase

Timing Diagrams

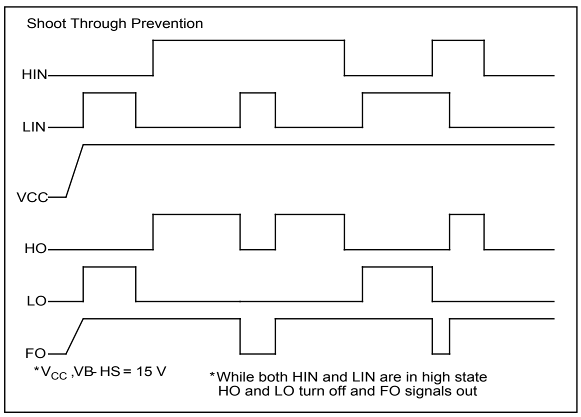
High-Side Driver Input/Output



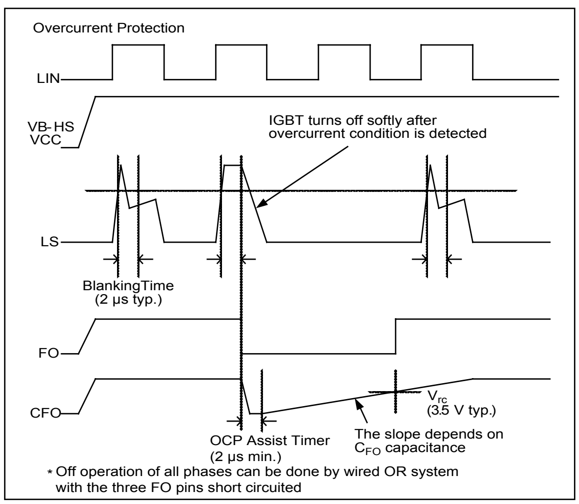
Low-Side Driver Input/Output



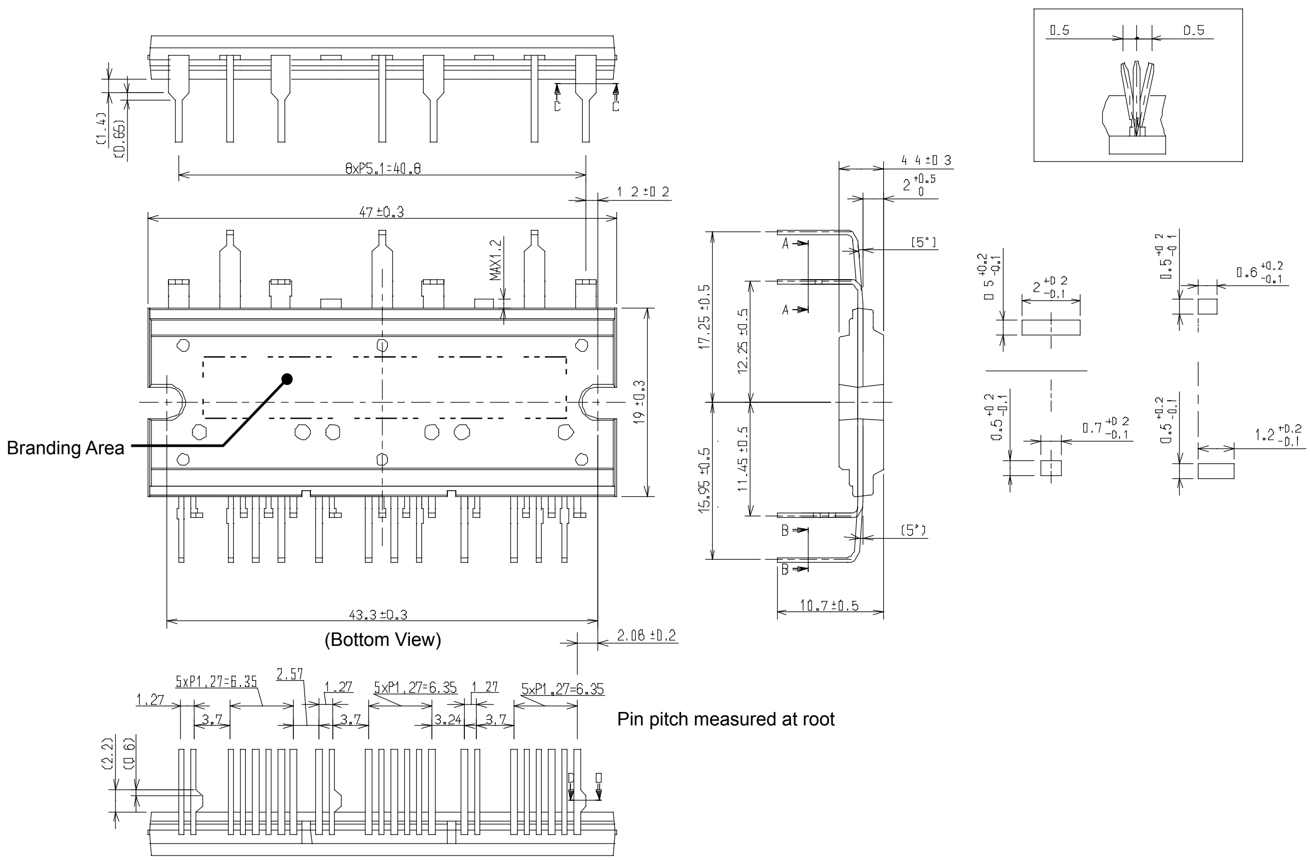
Shoot-Through Prevention



Overcurrent Protection



PACKAGE OUTLINE DRAWING



Leadform: 2551

Dimensions in millimeters

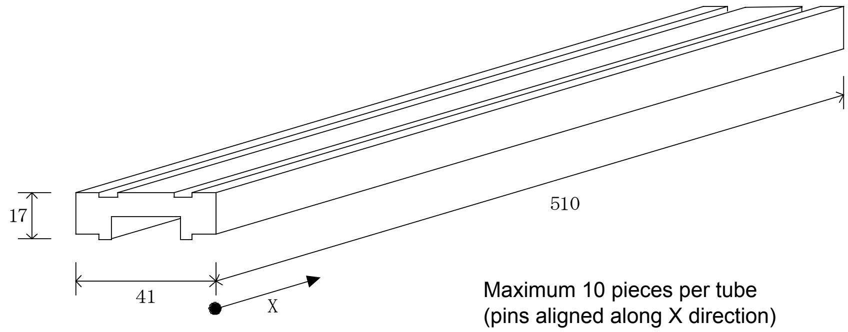
Branding codes (exact appearance at manufacturer discretion)
1st line, type: SCM1104M

2nd line, lot: *YMDDT*
Where: Y is the last digit of the year of manufacture
M is the month (*1* to *9, O, N, D*)
DD is the date
T is the tracking number

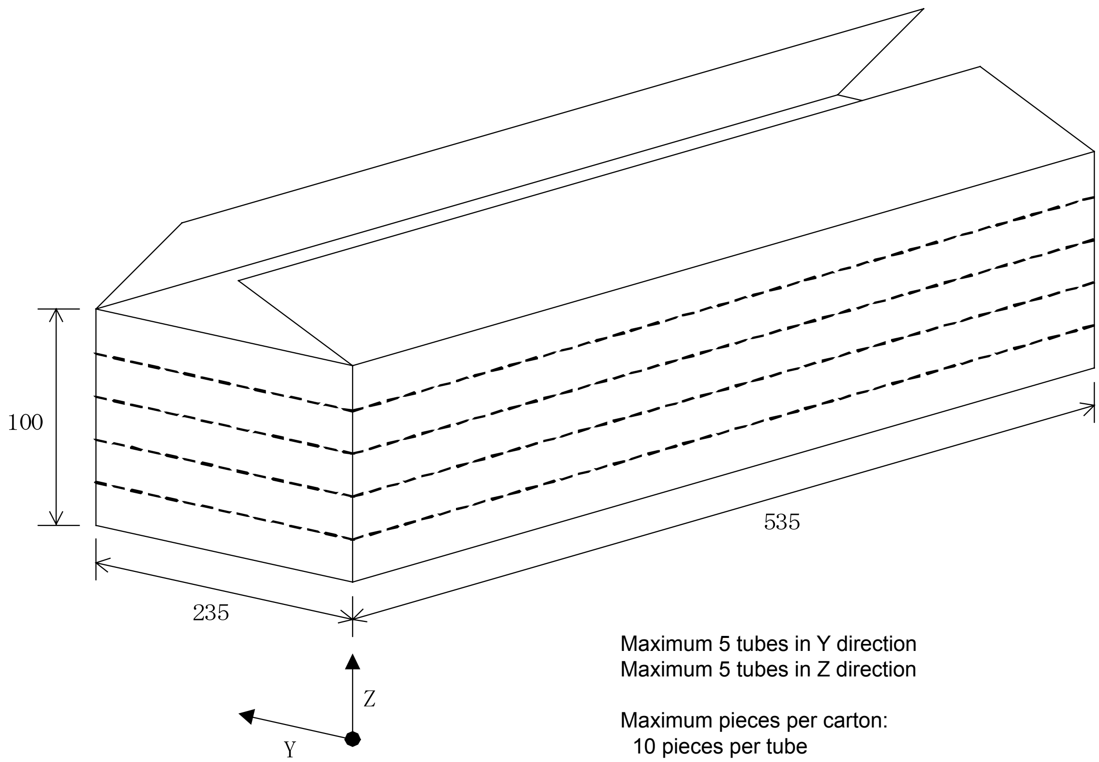
Leadframe plating Pb-free. Device composition complies with the RoHS directive.

PACKING SPECIFICATION

Dimensions in millimeters



Maximum 10 pieces per tube
(pins aligned along X direction)



Maximum 5 tubes in Y direction
Maximum 5 tubes in Z direction

Maximum pieces per carton:
10 pieces per tube
5 rows of tubes
x 5 layers of tubes
250 pieces per carton

Allegro MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000
www.allegromicro.com

WARNING — These devices are designed to be operated at lethal voltages and energy levels. Circuit designs that embody these components must conform with applicable safety requirements. Precautions must be taken to prevent accidental contact with power-line potentials. Do not connect grounded test equipment.

The use of an isolation transformer is recommended during circuit development and breadboarding.

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

Cautions for Storage

- Ensure that storage conditions comply with the standard temperature (5°C to 35°C) and the standard relative humidity (around 40 to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of products that have been stored for a long time.

Cautions for Testing and Handling

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between adjacent products, and shorts to the heatsink.

Remarks About Using Silicone Grease with a Heatsink

- When silicone grease is used in mounting this product on a heatsink, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce stress.
- Volatile-type silicone greases may permeate the product and produce cracks after long periods of time, resulting in reduced heat radiation effect, and possibly shortening the lifetime of the product.
- Our recommended silicone greases for heat radiation purposes, which will not cause any adverse effect on the product life, are indicated below:

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	GE Toshiba Silicone Co., Ltd.
SC102	Dow Corning Toray Silicone Co., Ltd.

Heatsink Mounting Method

Torque When Tightening Mounting Screws. The recommended tightening torque for this product package type is: 58.8 to 78.4 N•cm (6.0 to 8.0 kgf•cm).

Soldering

- When soldering the products, please be sure to minimize the working time, within the following limits:

  260±5°C 10 s

  380±5°C 5 s

- Soldering iron should be at a distance of at least 1.5 mm from the body of the products

Electrostatic Discharge

- When handling the products, operator must be grounded. Grounded wrist straps worn should have at least 1 MΩ of resistance to ground to prevent shock hazard.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in other to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in our shipping containers or conductive containers, or be wrapped in aluminum foil.

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SCM1104M

January, 2008

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