An Introduction to the SM-8 Package

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Introduction

Over recent years the benefits for companies to move to surface mount technology has lead to significant growth in the component industry. The requirements on the component suppliers is to provide either smaller components or components containing more than one device. The aim being to reduce PCB size and the number of component placements, thus reducing overall costs. Zetex is expanding it's range of surface mount packages to meet these demands. The first in this new series of packages to be introduced is the SM-8.

What is SM-8?

The SM-8 package has evolved from the industry standard SOT223 surface mount package. The development of a new lead frame, whilst maintaining the physical outline of the standard package, effectively gives two transistors in a package initially designed for one. Figure 1 illustrates the package.

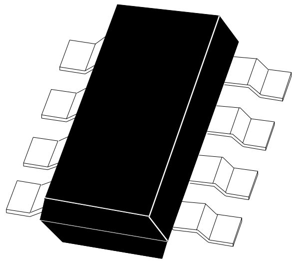


Figure 1
The SM-8 package.

Package Construction

The SM-8 is an eight pin device that can be configured in two ways due to different lead frame options. Both frame options enable two totally independent devices to be assembled into the same package.

The first frame option has eight independent pins enabling two devices that require four connections to be assembled in the package, for example two high side drivers, such as the Zetex ZHD100 BiMos switch.

The second frame option has two sets of two pins connected internally, effectively allowing the assembly of two devices requiring three connections, for example two Bipolar transistors or MOSFETs. The two common pins are internally connected to the frame onto which the transistor die is attached, and through which the collector or drain connection is made. This provides a low thermal resistance, and therefore allows a good transfer of heat away from the semiconductor chip through the frame, and onto the board or substrate.

The body of the device is a moulded epoxy and the leads are tin/lead plated. The dimensions of the package and pinout detail for transistors is provided in Appendix A.

Thermal Capability

The thermal capability of the package depends somewhat on the devices that are assembled within it, and will be detailed for each device assembly on the appropriate datasheet. However for illustrative purposes, the dual Bipolar transistor ZDT1048 device is used here as an example. Figures 2 and 3 show the transient and DC thermal resistance response for the ZDT1048 device, when one and two devices are powered respectively, and show DC values of thermal resistance of 55.6 and 45.5°C/W. This leads to a package power handling capability of 2.75W at an ambient temperature of 25°C, when both devices are turned on equally. If the circuit operation is such that only one of the devices is on at once, then the capable dissipation is 2.25W. The data for the above was derived from thermal resistance measurements with the package mounted on a standard FR4 PCB with a copper area of 2 inches square. As with any surface mount component, the actual thermal resistance achieved depends on many factors including the board area, the board material, proximity of passive and other components, and whether the board is single, double sided or multi-layer.

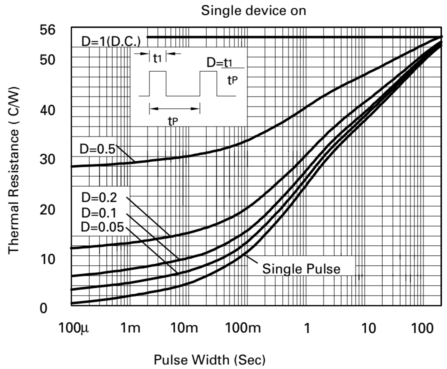


Figure 2
Transient Thermal Resistance Curves for the ZDT1048 - Single Device on.

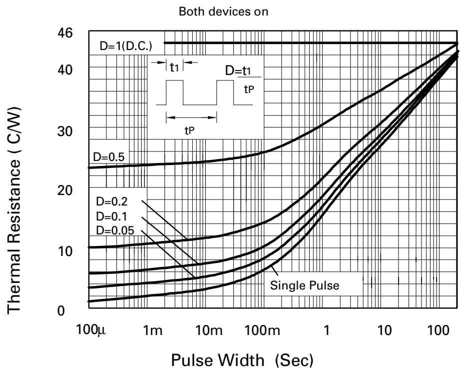


Figure 3
Transient Thermal Resistance Curves for the ZDT1048 - Both Devices on.

The latter is particularly effective in dissipating heat as the internal copper traces encourage lateral heat flow within the board, therefore possibly increasing the area from which the heat is dissipated. Figure 4 shows how the thermal resistance varies with single copper sided FR4 PCB area.

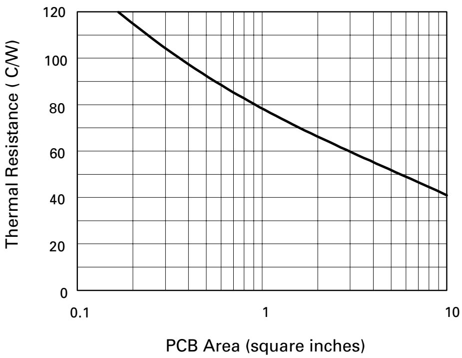


Figure 4
Thermal Resistance vs PCB Area (Single Copper Layer on FR4).

Electrical Specification

Theoretically any combination of two chips from the Zetex range of components can be assembled in the SM-8 package, however, commercial implications will be taken into consideration before introduction. This gives a potential current handling capability up to 5 Amps continuous with 20 Amps pulsed and voltages ranging from 10 to 450 Volts. Appendix B reproduces a datasheet for one of the dual transistor products - the ZDT1048. This device has been developed specifically for service within LCD Backlight Inverters.

Product Range

The product range is still in its infancy. New products are being introduced on a gradual basis as new opportunities are identified. An introductory range has been generated to demonstrate the options that are available to design engineers, This includes dual NPN or PNP transistors, NPN and PNP combinations, MOSFET combinations, dual high side drivers, and various Linear IC combinations.

Future developments will include dual IGBTs, and linear ICs/discrete component combinations.

Overall the SM-8 package offers Zetex and it’s customers the flexibility to provide innovative and cost effective circuit solutions.

Applications

For discrete component combinations the opportunities will lie in designs using push pull circuits, half or full bridges, Royer converters or high side drivers. These can be found in such applications as compact fluorescent ballasts, emergency lighting, LCD backlighting, motor drives and siren drivers.

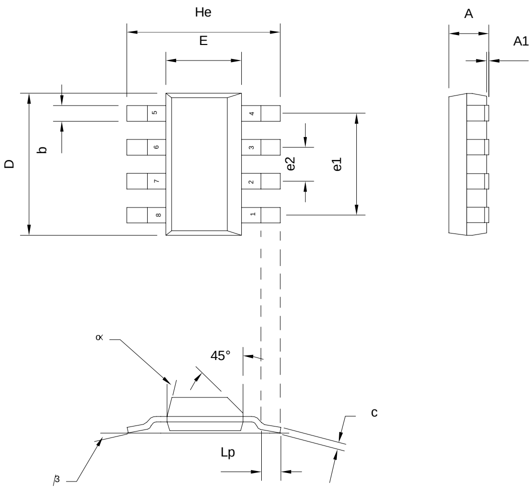
As an example of how the SM-8 package can transform a product, Figure 5 shows how Mitel Semiconductors have been able to reduce the size of their SLIC hybrid (part # MH88615) by replacing 4 SOT223 packaged devices with 2 SM-8s. The SLIC (Subscriber Line Interface Card) provides a complete interface between a switching system and a subscriber loop.

Figure 5
Mitel SLIC Hybrid using SM-8 Dual transistors.

Future Developments

Evaluation is ongoing of suitable four chip assemblies including a 'H'-Bridge configuration (4 transistors), an anti-parallel diode protected half-bridge (2 transistors and 2 diodes) and Schottky diode bridges. Plans are already underway to develop an 8 lead version of the smaller SOT23 package, again with the aim of offering two independent devices in one package. This part will be called the SSM-8, and it is expected that using variants of the SuperSOT geometry will enable the package to house two 15V devices, individually capable of conducting up to 3A continuous, and 12A under pulsed conditions.

Appendix A
Dimensional and Pinout details



PIN NUMBER	BIPOLARS	MOSFETS
1	E2	S2
2	B2	G2
3	E1	S1
4	B1	G1
5	C1	D1
6	C1	D1
7	C2	D2
8	C2	D2

Pinout details for dual Bipolar and MOSFET products.

Dim	Millimetres			Inches		
	Min	Typ	Max	Min	Typ	Max
A	–	–	1.7	–	–	0.067
A1	0.02	–	0.1	0.0008	–	0.004
b	–	0.7	–	–	0.028	–
c	0.24	–	0.32	0.009	–	0.013
D	6.3	–	6.7	0.248	–	0.264
E	3.3	–	3.7	0.130	–	0.145
e1	–	4.59	–	–	0.180	–
e2	–	1.53	–	–	0.060	–
He	6.7	–	7.3	0.264	–	0.287
Lp	0.9	–	–	0.035	–	–
α	–	–	15°	–	–	15°
β	–	10°	–	–	10°	–

Dimensional detail.

Appendix B
Sample Datasheet

SM-8 DUAL NPN MEDIUM POWER HIGH GAIN TRANSISTORS

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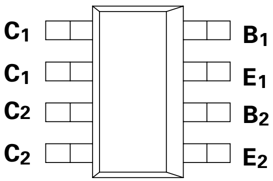
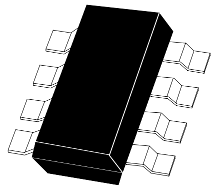
ZDT1048



PARTMARKING DETAIL – T1048



SM-8
(8 LEAD SOT223)

ABSOLUTE MAXIMUM RATINGS.

PARAMETER	SYMBOL	VALUE	UNIT
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	17.5	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current	I_{CM}	20	A
Continuous Collector Current	I_C	5	A
Base Current	I_B	500	mA
Operating and Storage Temperature Range	T_j:T_{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Total Power Dissipation at T_{amb} = 25°C* Any single die “on” Both die “on” equally	P_{tot}	 2.25 2.75	 W W
Derate above 25°C* Any single die “on” Both die “on” equally		 18 22	 mW/ °C mW/ °C
Thermal Resistance - Junction to Ambient* Any single die “on” Both die “on” equally		 55.6 45.5	 °C/ W °C/ W

* The power which can be dissipated assuming the device is mounted in a typical manner on a PCB with copper equal to 2 inches square.

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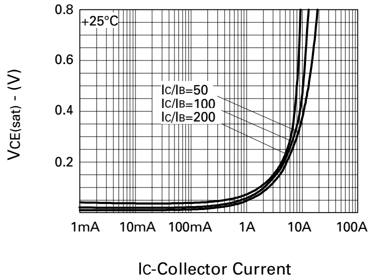
ELECTRICAL CHARACTERISTICS (at Tamb = 25°C unless otherwise stated).

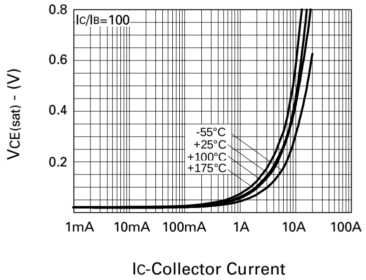
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS.
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	50	85		V	I_C=100μA
Collector-Emitter Breakdown Voltage	V_{CES}	50	85		V	I_C=100μA
Collector-Emitter Breakdown Voltage	V_{CEO}	17.5	24		V	I_C=10mA
Collector-Emitter Breakdown Voltage	V_{CEV}	50	85		V	I_C=100μA, V_{EB}=1V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	5	8.7		V	I_E=100μA
Collector Cutoff Current	I_{CBO}		0.3	10	nA	V_{CB}=35V
Emitter Cutoff Current	I_{EBO}		0.3	10	nA	V_{EB}=4V
Collector Emitter Cutoff Current	I_{CES}		0.3	10	nA	V_{CES}=35V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		27 55 120 200 200	45 75 160 240 300	mV mV mV mV mV	I_C=0.5A, I_B=10mA* I_C=1A, I_B=10mA* I_C=2A, I_B=10mA* I_C=5A, I_B=100mA* I_C=5A, I_B=50mA*
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		1000	1100	mV	I_C=5A, I_B=100mA*
Base-Emitter Turn-On Voltage	$V_{BE(on)}$		900	1000	mV	I_C=5A, V_{CE}=2V*
Static Forward Current Transfer Ratio	h_{FE}	280 300 300 250 50	440 450 450 300 80	 1200 		I_C=10mA, V_{CE}=2V* I_C=0.5A, V_{CE}=2V* I_C=1A, V_{CE}=2V* I_C=5A, V_{CE}=2V* I_C=20A, V_{CE}=2V*
Transition Frequency	f_T		150		MHz	I_C=50mA, V_{CE}=10V f=50MHz
Output Capacitance	C_{obo}		60	80	pF	V_{CB}=10V, f=1MHz
Switching Times	t_{on}		120		ns	I_C=4A, I_B=40mA, V_{CC}=10V
	t_{off}		250		ns	I_C=4A, I_B=±40mA, V_{CC}=10V

*Measured under pulsed conditions. Pulse width=300μs. Duty cycle ≤ 2%

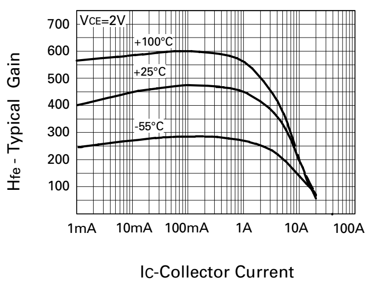
TYPICAL CHARACTERISTICS



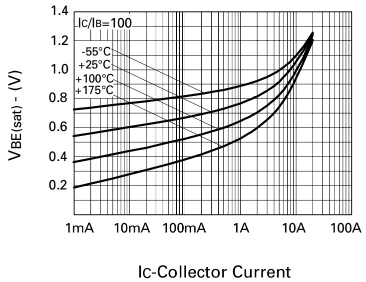
VCE(sat) v IC



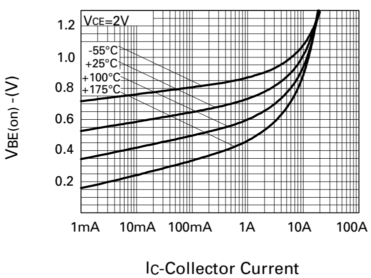
VCE(sat) v IC



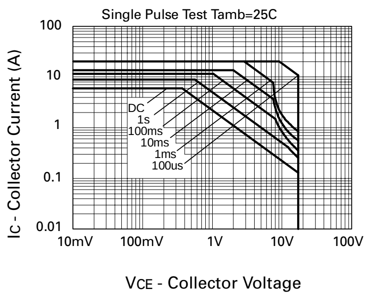
hFE v IC



VBE(sat) v Ic



VBE(on) v IC



Safe Operating Area

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