



ISO 11'784 / 11'785 Compliant Read Only Contactless Identification Device

Description

The EM4005/EM4105 (previously named H4005/H4105) is a CMOS integrated circuit intended for use in electronic Read Only RF Transponders. The circuit is powered by an external coil placed in an electromagnetic field, and gets its master clock from the same field via one of the coil terminals. The other coil terminal is affected by the modulator. By turning on and off the modulation current, the chip will send back the 128 bits of information contained in a factory pre-programmed memory array.

The programming of the chip is performed by laser fusing of polysilicon links in order to store a unique code on each chip.

Due to the low power consumption of the logic core, no supply buffer capacitor is required. Only an external coil is needed to obtain the chip function. A parallel resonance capacitor of 75 pF is also integrated.

Features

- 128 bit memory array laser programmable
- Bit duration : 32 periods of RF field
- Bit coding according to ISO FDX-B
- On chip resonance capacitor
- On chip supply buffer capacitor
- Wide dynamic range
- On chip voltage limiter
- Full wave rectifier
- Large modulation depth
- Operating frequency 100 - 150 kHz
- Very small chip size convenient for implantation
- Very low power consumption

Applications

- Animal implantable transponder
- Animal ear tag
- Industrial transponder

Typical Operating Configuration

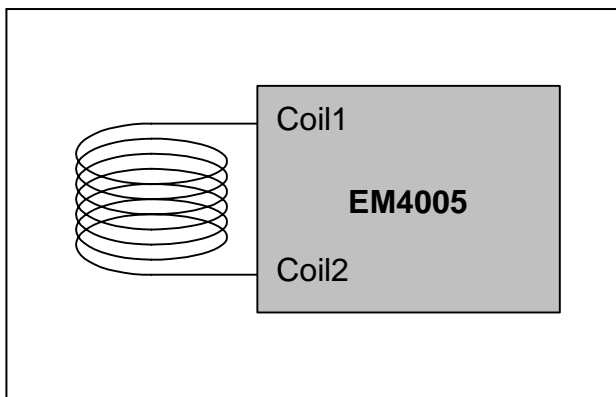


Fig. 1

Pin Assignment

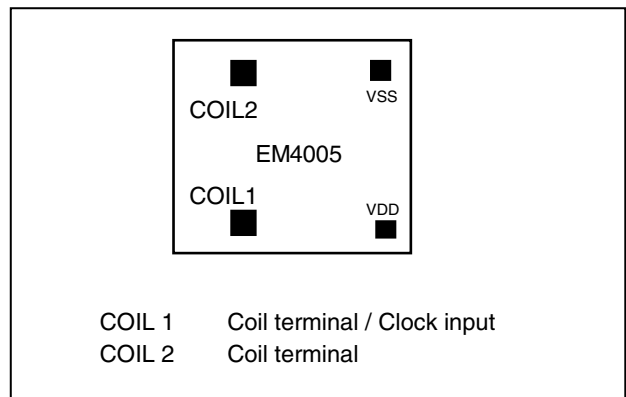


Fig. 2

Absolute Maximum Ratings

Parameter	Symbol	Conditions
Maximum AC peak Current induced on COIL1 and COIL2	ICOIL	± 30 mA
Power Supply	V _{DD}	-0.3 to 7.5 V
Storage temperature Die form	T _{store}	-55 to +200°C
Storage temperature PCB form	T _{store}	-55 to +125°C
Electrostatic discharge maximum to MIL-STD-883C method 3015	VESD	1000 V

Stresses above these listed maximum ratings may cause permanent damages to the device. Exposure beyond specified operating conditions may affect device reliability or cause malfunction.

Handling Procedures

This device has built-in protection against high static voltages or electric fields; however, anti-static precautions must be taken as for any other CMOS component. Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the voltage range. Unused inputs must always be tied to a defined logic voltage level.

Operating Conditions

Parameter	Symb	Min	Typ	Max	Unit
Operating Temp.	Top	-40		+85	°C
Maximum coil current	ICOIL			10	mA
AC Voltage on Coil	V _{coil}		14*		V _{pp}
Supply Frequency	f _{coil}	100		150	kHz

*) The AC Voltage on Coil is limited by the on chip voltage limitation circuitry.

System Principle

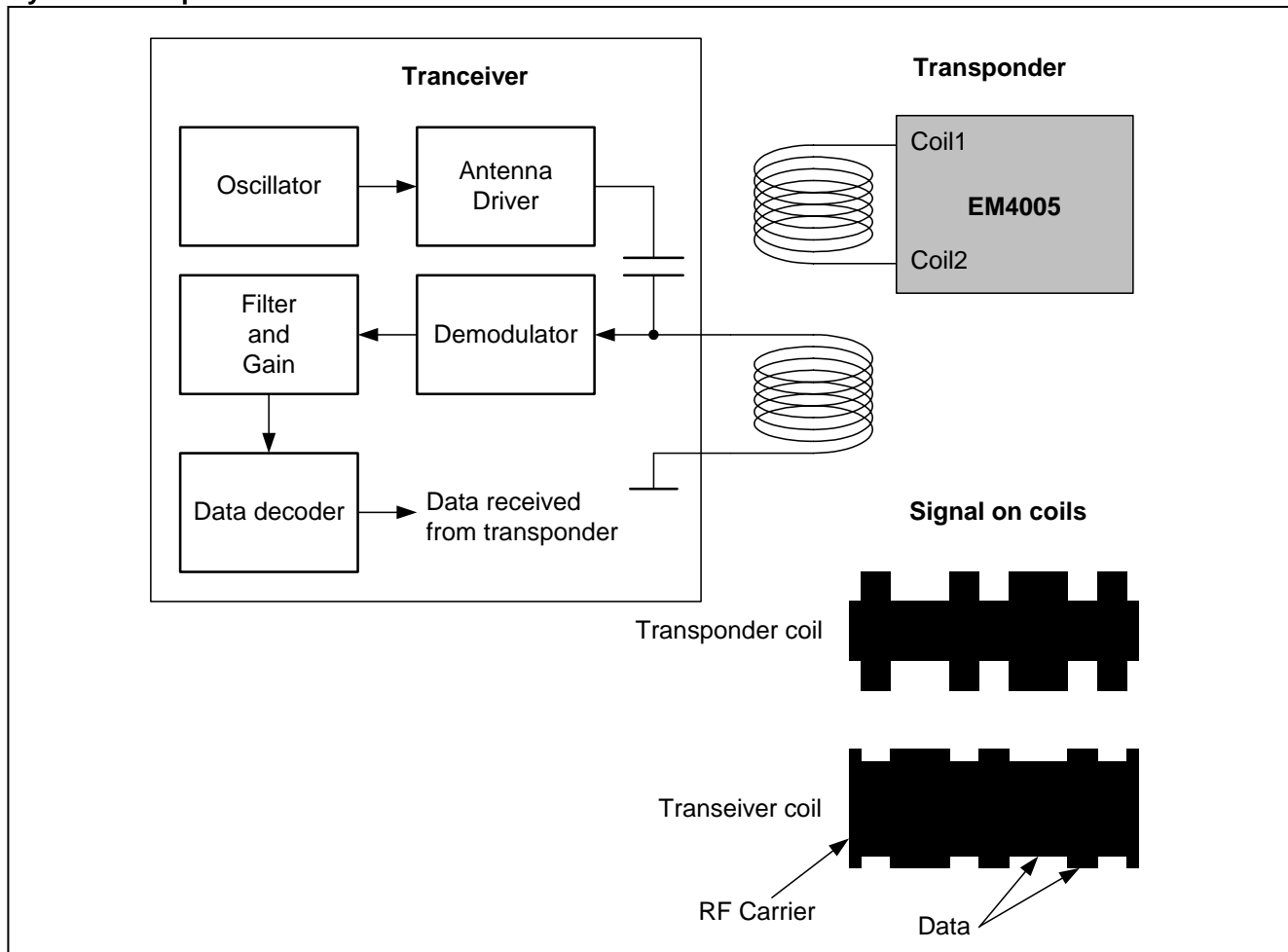


Fig. 3

Electrical Characteristics

$V_{DD} = 1.5\text{ V}$ $V_{SS} = 0\text{ V}$ $f_{coil} = 134\text{ kHz}$ Square wave $T_{op} = 25^\circ\text{C}$
 $V_{C1} = 1.0\text{ V}$ with positive peak at V_{DD} and negative peak at $V_{DD} - 1\text{ V}$

unless otherwise specified

Parameter	Symbol	Test conditions	Min	Typ	Max	Units
Supply Voltage	V_{DD}		1.5		¹⁾	V
Supply Current	I_{DD}				1.5	μA
Rectified Supply Voltage	V_{DD}	$V_{C2} - V_{C1} = 2.8\text{ VDC}$ Modulator Switch = "ON"	1.5			V
C2 pad Modulator ON voltage drop	V_{ONC2}	$V_{DD} = 1.5\text{V}$ $I_{VDDC2} = 100\ \mu\text{A}$ with ref. to V_{DD}	0.9 2.1		1.3 3.0	V V
C1 pad Modulator ON voltage drop	V_{ONC1}	$V_{DD} = 5.0\text{V}$ $I_{VDDC2} = 1\text{ mA}$ with ref. to V_{DD}	2.1		3.0	V
Coil1 - Coil2 capacitance	C_{res}	$V_{DD} = 5.0\text{V}$ $I_{VDDC1} = 1\text{ mA}$ with ref. to V_{DD}		75 ²⁾		pF
Power Supply Capacitor	C_{sup}	$V_{coil} = 100\text{ mVRMS}$ $f = 10\text{ kHz}$		150		pF

Note 1) The maximum voltage is defined by forcing 10 mA on C1 - C2

Note 2) The tolerance of the resonant capacitor is $\pm 15\%$ over the whole production. On a wafer basis and on process statistics, the tolerance is $\pm 2\%$

Timing Characteristics

$V_{DD} = 1.5\text{ V}$ $V_{SS} = 0\text{ V}$ $f_{coil} = 134\text{ kHz}$ Sine wave $T_{op} = 25^\circ\text{C}$

$V_{C1} = 1.0\text{ V}$ with positive peak at V_{DD} and negative peak at $V_{DD} - 1\text{ V}$

unless otherwise specified

Timings are derived from the field frequency and are specified as a number of RF periods.

Parameters	Symbol	Test Conditions	Value	Units
Read bit period	trdb		32	RF periods

Timing Waveforms

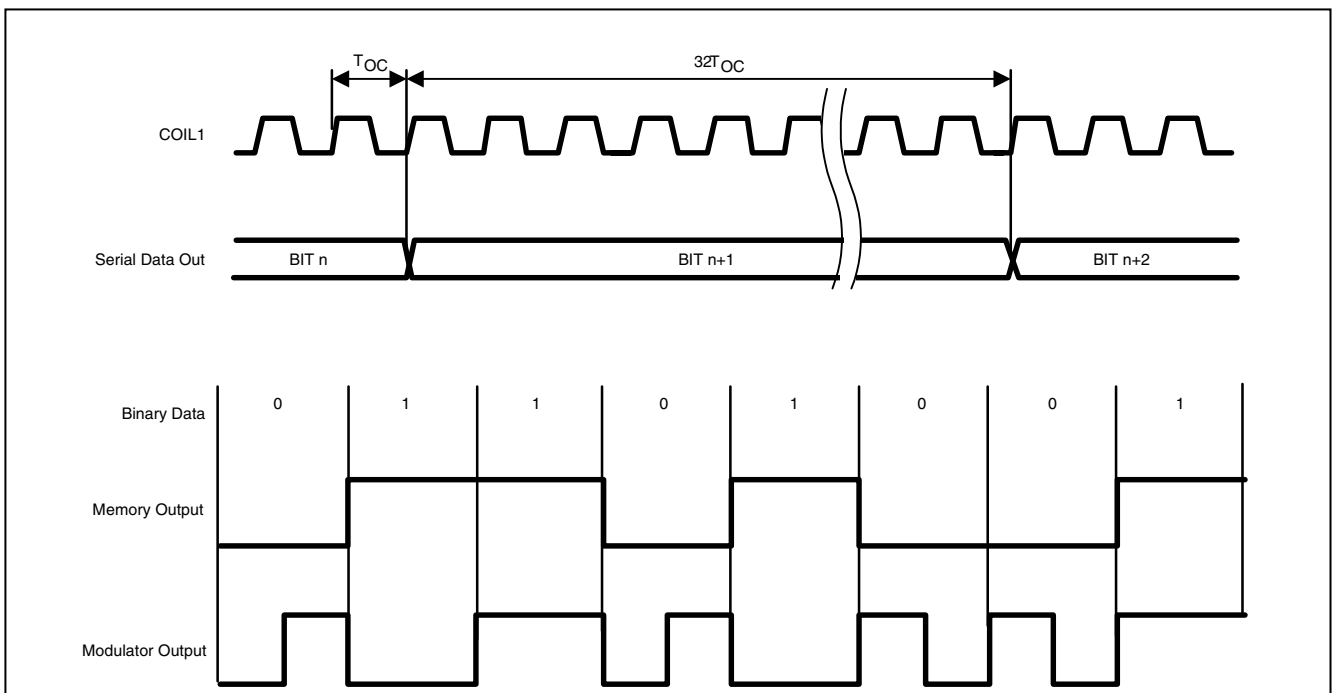


Fig. 4

Block Diagram

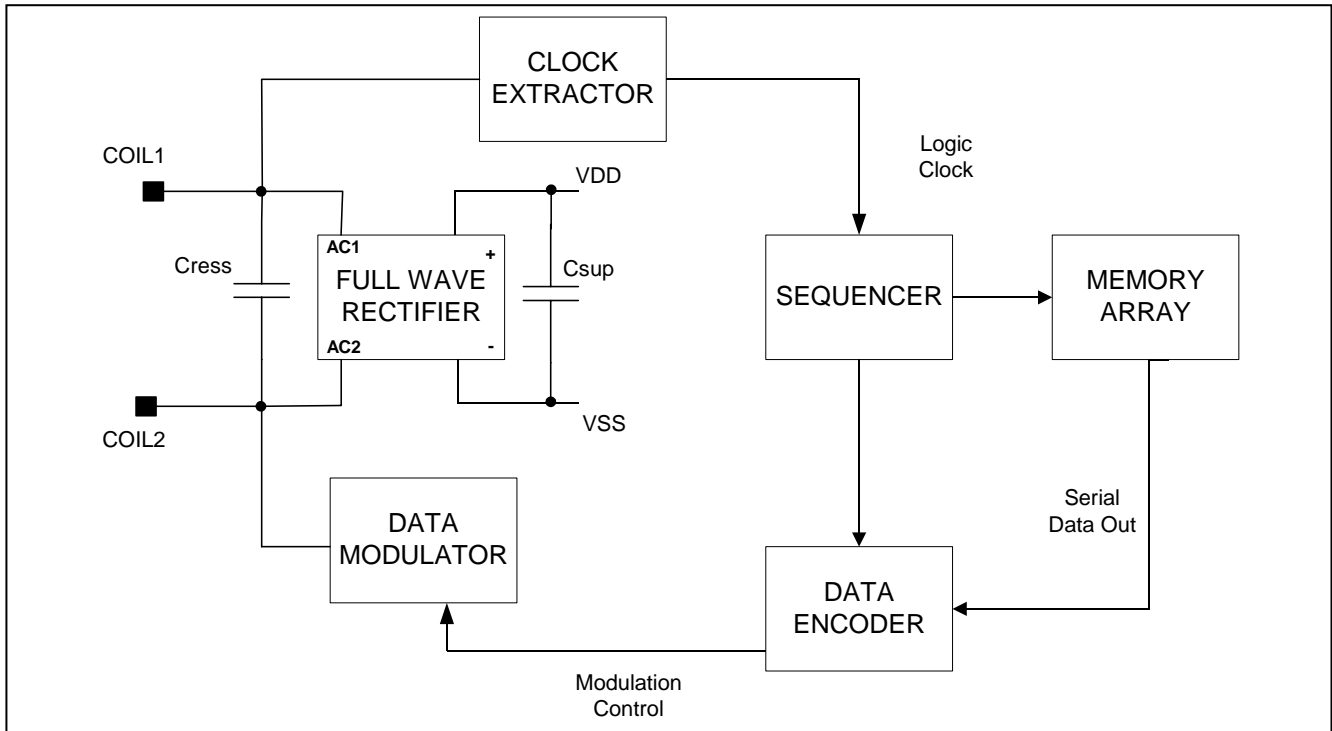


Fig. 5

Functional Description

General

The EM4005 is supplied by means of an electromagnetic field induced on the attached coil. The AC voltage is rectified in order to provide a DC internal supply voltage. When the DC voltage is sufficient the chip sends data continuously. When the last bit is sent, the chip will continue with the first bit until the power goes off.

Full Wave Rectifier

The AC input induced in the external coil by an incident magnetic field is rectified by a Graetz bridge. The bridge will limit the internal DC voltage to avoid malfunction in strong fields.

Clock extractor

One of the coil terminals (COIL1) is used to generate the master clock for the logic function. The output of the clock extractor drives a sequencer.

Sequencer

The sequencer provides all necessary signals to address the memory array and to encode the serial data out. The data rate is set to 32 clocks per bit.

Data Encoder

The data is coded according to the FDX-B scheme. At the beginning of each bit, a transition will occur. A logic bit "1" will keep its state for the whole bit duration and a logic bit "0" will show a transition in the middle of the bit duration (refer to fig. 4).

The FDX-B allows an advance of up to 8 clocks in the ON to OFF transition. Due to its low power consumption, there is no difference in performance for the H4005 when implementing a transition advance. No clock advance is provided on the standard version.

Data Modulator

The data modulator is controlled by the signal Modulation Control in order to induce a high current on COIL2 terminal when this signal is at logic "0". This will affect the magnetic field according to the data stored in the memory array.

Memory

The memory contains 128 bits laser programmed during manufacturing according to a customer list of codes. The bits are read serially in order to control the modulator. The 128 bits output sequence is repeated continuously until power goes off.

Memory Map

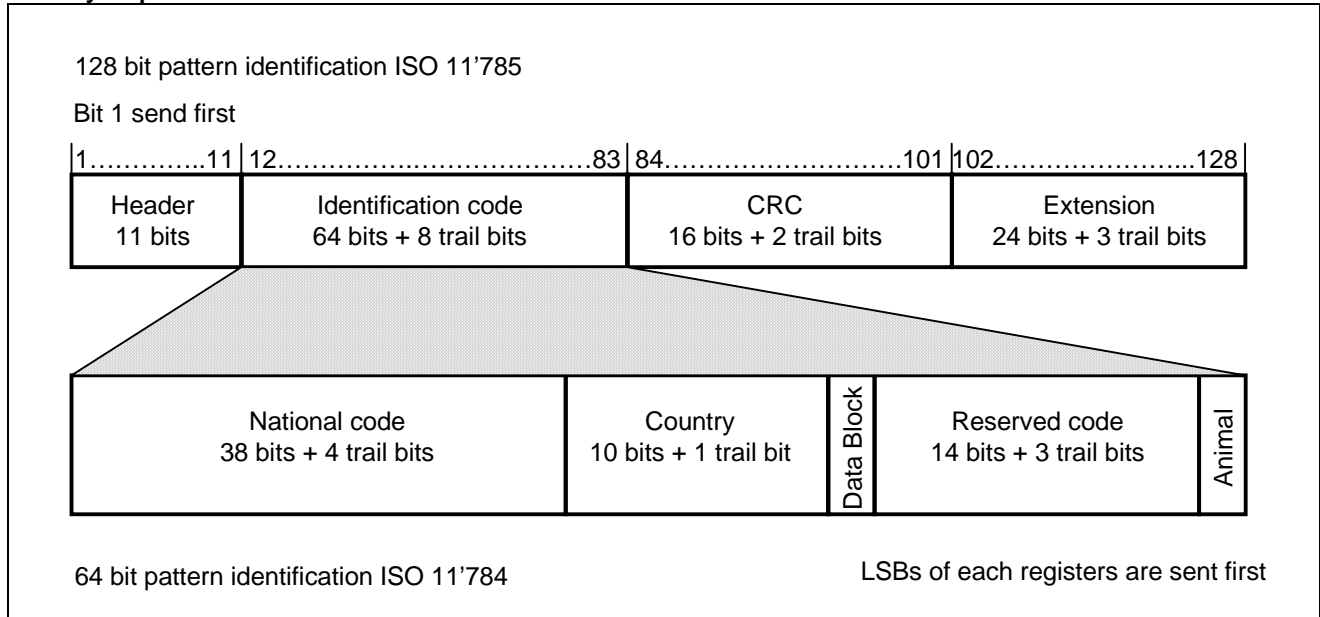


Fig. 6

Memory organisation

The structure of the 128 bits is as follows :

The header is sent first and is used to identify the start of the sequence. It is composed of 11 bits having a bit pattern which is unique in the data stream. **0000000001**

The header is followed by the **Identification code** which is composed of 64 bits organised in 8 blocks of 8 bits. Each block of 8 bits is trailed by a control bit set to logic "1" to prevent that the header is reproduced in the data. Bit 64 is transmitted first.

Bit 1 is a flag for animal "1" or non-animal "0" application.
 Bits 2-15 are a reserved code for future use.
 Bit 16 is a flag for additional data block "1" or no additional data block "0".
 Bits 17-26 ISO 3166 Numeric country code
 Bits 27-64 National identification code

The next two 8 bit blocks contain the **16 CRC-CCITT** error detection bits. LSB is transmitted first, and the 2 block are trailed with a binary "1".

The data stream with 3 blocks of 8 bits trailed with a logical "1" representing the extension bits. The extension bits are planned for future extension in which for instance information from sensors or contents of trailing pages may be stored. In the current version the standard coding will

be **000000001 000000001 000000001** and the flag bit 16 of the identification code "0".

Resonance Capacitor

The Resonance Capacitor is integrated, and its value is typically 75 pF.

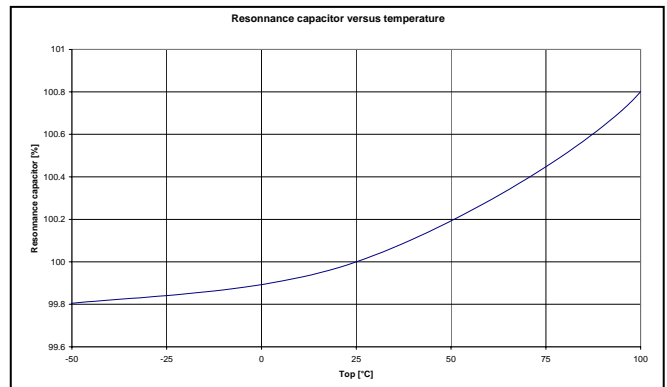
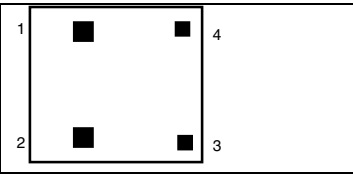


Fig. 7

Pad Description

Pad	Name	Function
1	COIL2	Coil terminal 2 / data output
2	COIL1	Coil terminal 1 / clock input
3	VDD	Positive internal supply voltage
4	VSS	Negative internal supply voltage



Package Information

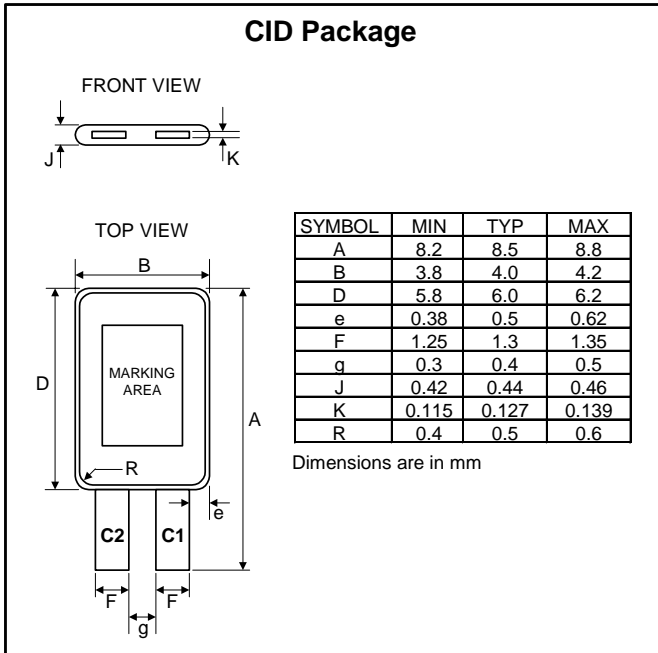


Fig. 8

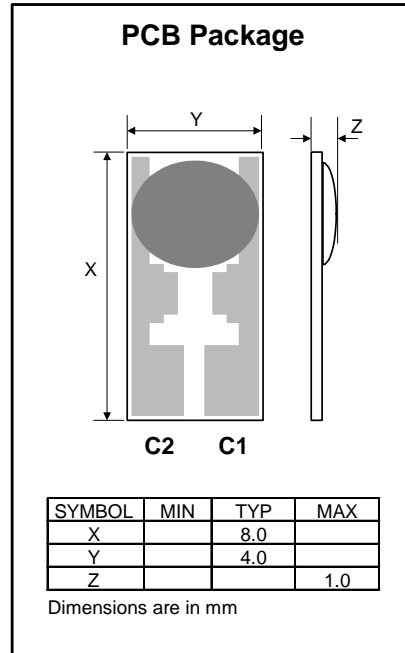


Fig. 9

Chip Dimensions

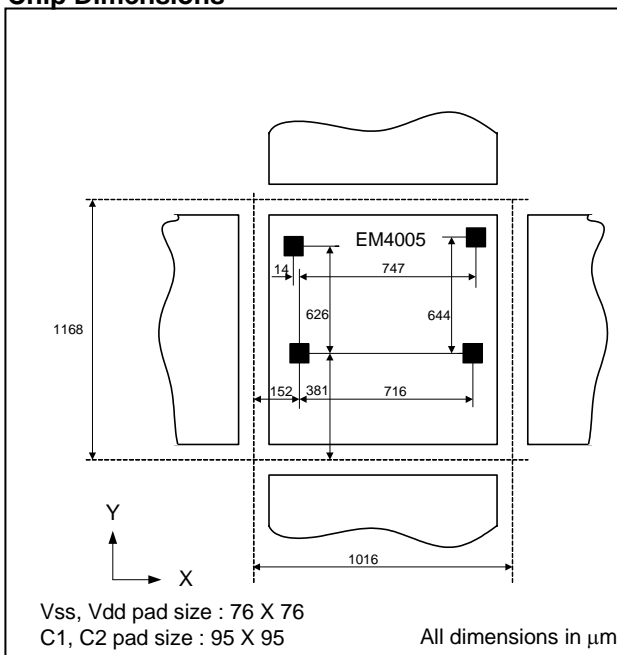


Fig. 10

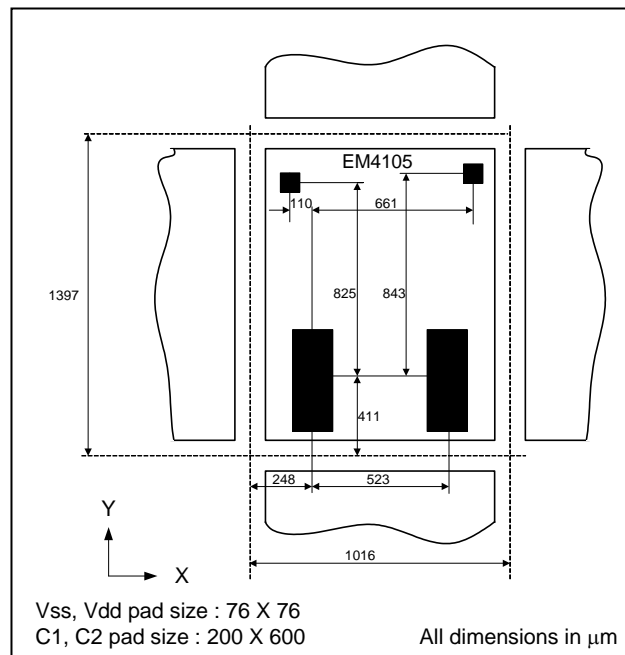


Fig. 11

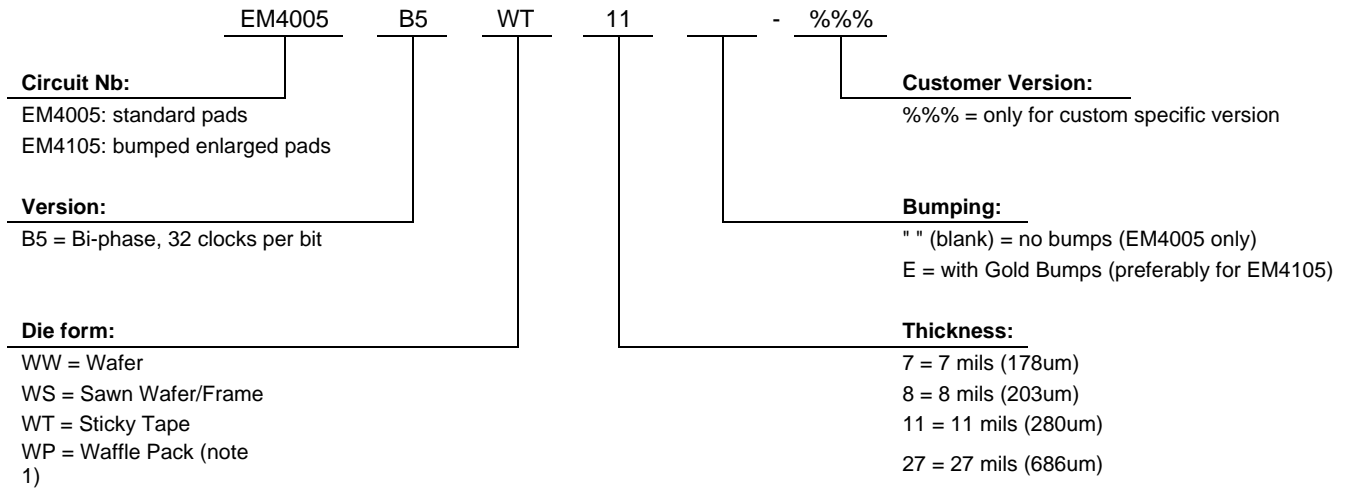


EM4005 EM4105

Ordering Information

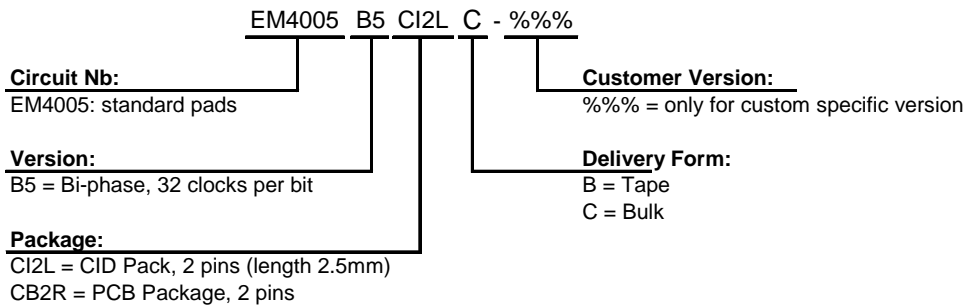
Die Form

This chart shows general offering; for detailed Part Number to order, please see the table "Samples Versions" below.



Packaged Devices

This chart shows general offering; for detailed Part Number to order, please see the table "Samples Versions" below.



Remarks:

- For ordering please use table of "Standard Version" table below.
- For specifications of Delivery Form, including gold bumps, tape and bulk, as well as possible other delivery form or packages, please contact EM Microelectronic-Marin S.A. Sales Office
- **Note 1:** This is a non-standard package. Please contact EM Microelectronic-Marin S.A. Sales Office for availability.



EM4005 EM4105

Samples Versions

The versions below are samples and should be readily available. For other versions or other delivery form, please contact EM Microelectronic-Marin S.A. Sales Office. Please make sure to give complete part number (without spaces) when ordering.

Part Number	Bit coding	Cycle/bit	Pads	Package/Die Form	Delivery Form / Bumping	For EM internal use only	
						old version	OPS#
EM4005 B5 CB2RC	Bi-phase	32	Standard	PCB Package, 2 pins	bulk	999	2653
EM4005 B5 CI2LC	Bi-phase	32	Standard	CID package, 2 pins (length 2.5mm)	bulk	999	2951
EM4005 B5 WP11	Bi-phase	32	Standard	Die in waffle pack, 11 mils	no bumps	999	2655
EM4005 B5 WS7	Bi-phase	32	Standard	Sawn wafer, 7 mils	no bumps	999	3155
EM4005 B5 YYY-%%%	Bi-phase	32	Standard	custom	no bumps	%%%	
EM4105 B5 WP11E	Bi-phase	32	Bumped enlarged pad	Die in waffle pack, 11 mils	with gold bumps	999	3165
EM4105 B5 WT11E-A	Bi-phase	32	Bumped enlarged pad	Die on sticky tape, 11 mils	with gold bumps	999	2857
EM4105 B5 YYY-%%%	Bi-phase	32	Bumped enlarged pad	custom	with gold bumps	%%%	

Warning: According to ISO U784/85 rules, the version "999" is intended to be used for transponder qualification purposes only – animals shall never be tagged with this version.

Maximum ordering quantity of version "999" is limited to 10kpcs.

For ICs to be used in mass production, the customer must define ROM fields. EM Microelectronic-Marin S.A. Sales Office will define a complete new part name for ordering.

Product Support

Check our Web Site under Products/RF Identification section.

Questions can be sent to cid@emmicroelectronic.com

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