

**ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE  
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH**

Laboratoire Européen pour la Physique des Particules  
European Laboratory for Particle Physics

# **Market Survey**

**MS-2878/EP/CMS**

## **Supply of BTI Multi-Chip Modules for the CMS Barrel Muon Detector**

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Contains:

### **I. Technical Description**

### **II. Qualification Criteria**

### **III. Questionnaire**

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#### **Abstract**

The purpose of this Market Survey is to establish a list of companies able to supply approximately 12500 Multi-Chip Modules. Each module consists of four ASICs (Bunch crossing and Time Identifier, BTI) and some passive components lodged on a ceramic substrate (not beryllia). The BTI ASICs, will be supplied directly by I.N.F.N. to the company or will have to be procured by the company from an appointed supplier; this decision will be taken by the time the Invitation to Tender is issued.

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# I. Technical Description

## 1. Introduction

The European Organization for Nuclear Research, CERN, is an Intergovernmental Organization with 20 European member states. CERN has its seat in the Canton of Geneva (Switzerland) but its laboratories are located on both sides of the Swiss-French border. CERN is running a number of particle accelerators, the largest being the Large Electron Positron Collider (LEP).

The Large Hadron Collider (LHC) project, a large proton-proton collider and superconducting accelerator of 27km in circumference, was approved in 1994. The LHC will be the next major research tool for world particle physics and it is expected to be commissioned in 2005.

CMS is one of the two main experiments which will be installed at this accelerator to measure hadron-hadron collisions. The Barrel Muon chambers are situated inside pockets of the iron yoke and track the trajectories of the outgoing muons. Trigger and readout electronics are lodged in mini-crates on the chambers. The Trigger Boards provide trigger primitives for muon identification and selection by means of three dedicated ASICs: BTI, TRACO and TSS. BTIM is the multi-chip module providing a compact packaging for Bunch Crossing Identifier ASICs (BTI). Since mini-crates will be installed on the detector, parts reliability is of concern and tests will be required on assembled products in order to get the best screening of defects.

## 2. Purpose and scope of the Market Survey

The purpose of this market survey is to identify companies specialized in the manufacturing of ceramic Multi-Chip-Modules (MCM), able to integrate into these modules four ASICs with the necessary quality and reliability. BTI ASICs, an I.N.F.N. project, will be supplied to the company directly by I.N.F.N. or will have to be procured by the company from an appointed supplier.

CERN intends to issue an Invitation to Tender for the production of BTIMs. Only companies which have thoroughly answered the Questionnaire and have fulfilled the Qualification Criteria as set out in part II of this Market Survey will be consulted for the forthcoming invitation to tender.

## 3. Quantity and Delivery

The period foreseen for tendering and adjudication goes from the last quarter of 2000 to the first quarter of year 2001. The required quantity of BTIMs is about 12500.

The company shall provide a prototype lot of 50 modules within the third quarter of 2001 and a pre-series production of about 950 modules within the end of 2001, all modules must be tested according to the Technical Specifications and will be verified by CERN/CMS Collaboration. Series production will be authorized only after approval of the prototype and pre-series production. CERN reserves the right to terminate the contract in case of failure of the prototypes or the pre-production to meet these conditions, without any compensation being due to the contractor with regard to such termination.

The production should be compatible with a delivery schedule covering a 2 year period from mid-2002 to mid-2003, with deliveries being spread evenly during this period.

The preferred delivery schedule is:

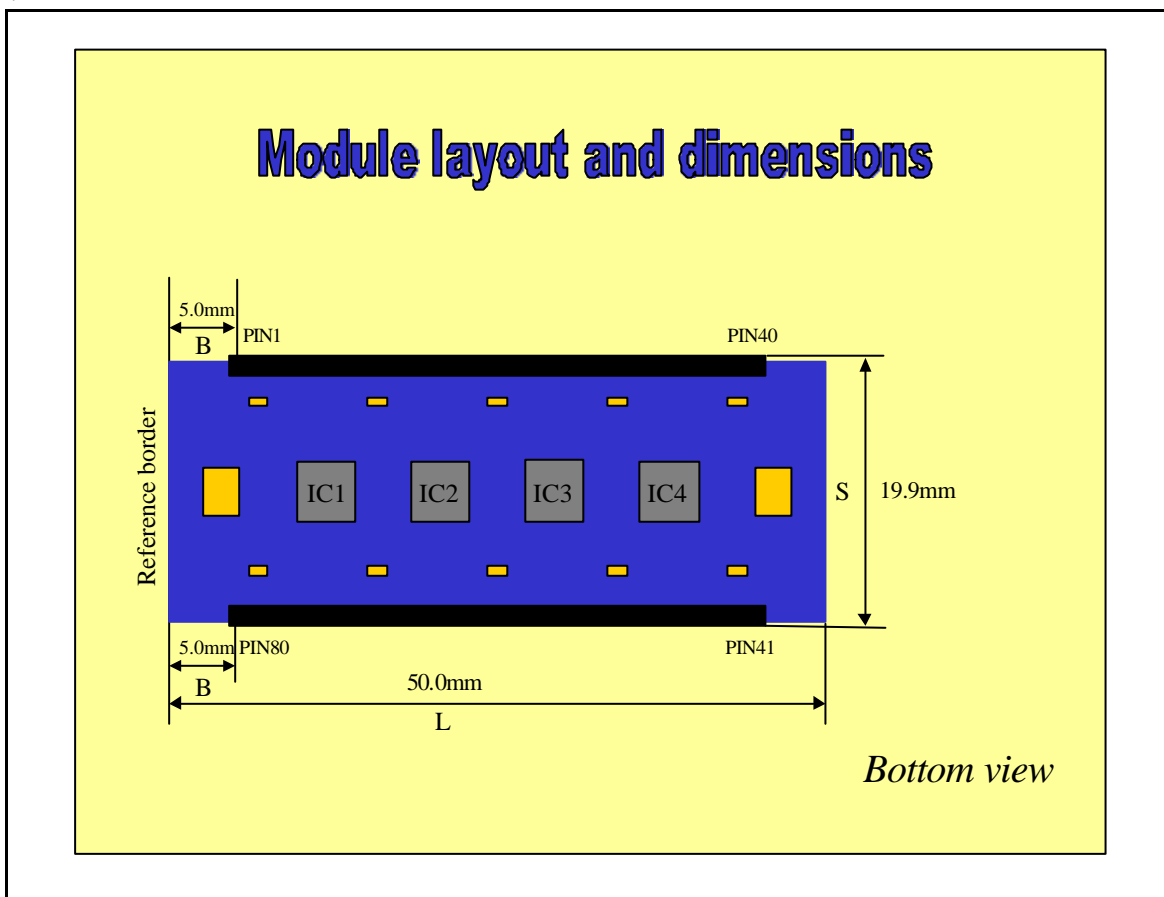
- Prototype production: 50 pieces by September 2001.

- Pre-series production: 950 pieces by December 2001.
- Series production: 5 lots of 2300 pieces each, delivered by March 2002, June 2002, December 2002, and March 2003 and June 2003.

#### 4. Technical requirements

The BTIM is a multi-chip module (see the drawing), consisting of four ASICs and some passive components lodged on a ceramic substrate (not beryllia). Substrate dimensions are: 50 mm long (L) by 19.5 mm wide (W) by 0.6 mm thick (T). Four unpackaged BTI (“known good dies”), eight ceramic capacitors (0.01 $\mu$ F X7R SMD case) and two tantalum capacitors (4.7  $\mu$ F 6.3V SMD case B, 3528 EIA-norm) are glued on the substrate bottom side. Dies are bonded to substrate pads using 62 wires each with a minimum pad pitch of 100 $\mu$ m and a passivation opening of 85 $\mu$ m x 85 $\mu$ m. A ground plane must be provided on the substrate top side for shielding. Module pinout is dual-in-line with 80 pins SMT at 1.02 mm (40 mils) pitch (series 22AA from [NAS Interplex](#)). Module height with terminations (H) must be 3.3 mm and module width (S) 19.9 mm.

Particular care is required in the centering of pins with respect to substrate borders. The distance between the reference border (see parts IV: Drawings) and pins 1 and 80 center axis (B) must be 5.0 mm.



Module dimensions and tolerances are:

L : 50.0 $\pm$ 0.1 mm	substrate length
W : 19.5 $\pm$ 0.1 mm	substrate width
T : 0.6 $\pm$ 0.05 mm	substrate thickness
H : 3.3 $\pm$ 0.2 mm	module height
S : 19.9 $\pm$ 0.1 mm	module width
B : 5.0mm $\pm$ 0.1 mm	distance of pins 1 and 80 from module reference border

The modules will be operated at 3.3 V and will dissipate 1 W running at 80 MHz.  
The operating environment is defined in the following table:

#	environmental specifications	min	typ	max	unit	note
5.1	Operating temperature	0	40	70	°C	
5.2	Storage temperature	-20	20	70	°C	
5.3	Operating humidity			60	%RH	13°C dew point

An electrical test will be required to verify connectivity and bonding integrity after module assembling; JTAG circuitry integrated in the BTI will be used to perform this test. A functional test will be required to verify the module at full speed; dynamic vectors must be generated at 40MHz while module output must be acquired at 80MHz. The supplier will be provided with stimuli vector files for connectivity and functional tests and MCM sockets in adequate quantity.

Since access to trigger electronics will be difficult during CMS operating life, BTIM reliability has to be verified. Samples of production lots will be checked following standard procedures like, for example, MIL-STD-883 methods 1010 (temperature cycling), 1030 and 1015 (burn-in) and 1005 (steady-state life test) (MIL standards are available at the [STINET](#) web page). Should the analysis of the defective devices indicate that the failure mechanism is due to poor basic processing procedures, a basic design fault, or non-screenable defects, the lot will be rejected. In case of defective lots CERN/CMS has the right to decide on the proper corrective and preventive actions to be taken.

Contractors will be required to propose a screening procedure for production. The contractor shall maintain a record of the detected failures in terms of number of defective MCM devices and when the failure has been detected.

The contractor is responsible for ensuring that all the necessary precautions are taken to maintain the specific manufacturing processes in use, under control during the MCM production, in order to assure repeatability and production homogeneity.

## 5. Persons in Charge

**Commercial Contact:** Dante Gregorio  
CERN, SPL Division  
CH1211 Geneva 23  
Tel: + 41 22 767 6335  
Fax: + 41 22 767 7530  
E-mail: [Dante.Gregorio@cern.ch](mailto:Dante.Gregorio@cern.ch)

*In case of absence:* Paula Ribeiro  
CERN, SPL Division  
CH1211 Geneva 23  
Tel: + 41 22 767 6991  
Fax: + 41 22 767 7530  
E-mail: [Paula.Ribeiro@cern.ch](mailto:Paula.Ribeiro@cern.ch)

**Technical Contact** R. Martinelli

Tel: + 39 49 8277206  
Fax: + 39 49 8277102  
E-mail: [roberto.martinelli@pd.infn.it](mailto:roberto.martinelli@pd.infn.it)

In case of absence: U. Dosselli  
Tel: + 39 49 8277109  
Fax: + 39 49 8756233  
E-mail: [umberto.dosselli@pd.infn.it](mailto:umberto.dosselli@pd.infn.it)

## II. Qualification criteria

In order to be considered for the forthcoming call for tenders, all the following criteria must be met:

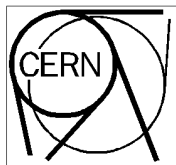
### Technical criteria

1. The proposed multi-chip modules must fulfil all technical and environmental requirements, as specified in paragraph 4 (Technical Requirements) of the Technical Description;
2. The company must guarantee a direct contact with the technical responsible or delegated person named in paragraph 5 (Persons in charge) of the Technical Description;
3. The company must inform the technical responsible, and receive his authorization prior to making any change(s) to the product and/or its sub-components. Modified products will be subject to re-qualification by the technical staff;
4. The company should have experience in manufacturing ceramic substrates and in multi-chip assembling using die bonding. In case the company intends to subcontract part of the work, experience of all major subcontractors must also be demonstrated. CERN reserves the right to request samples of similar MCMs from the company or its subcontractors in order to provide evidence of experience in this field.

### Other criteria

5. The company must be registered in one of the CERN Member States or in one of the countries collaborating in CMS.
6. All documents should be written in English or French.
7. The company must demonstrate its ability to produce over 7000 multi-chip modules per year;
8. The company must have had an average annual turnover of at least 3M Swiss Francs over the last 3 years;
9. The company must have a registered Quality Assurance Plan satisfying the requests of ISO9000 or equivalent national standards;
10. In the event of being awarded a contract, the company must agree to procure ASIC chips from an appointed supplier, if requested;
11. The company must return to CERN the enclosed questionnaire duly filled in by Oct.31, 2000.





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### **III. Questionnaire**

(To be returned in duplicate by the companies interested in tendering before Sept. 30, 2000)

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**Company:**

Name: .....

Address: .....

.....

**Commercial Contact Person**

.....

Telephone Number

.....

Fax Number

.....

Electronic Mail

.....

***In case of absence:***

Commercial Contact Person

.....

Telephone Number

.....

Fax Number

.....

Electronic Mail

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**Technical Contact Person**

.....

Telephone Number

.....

Fax Number

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Electronic Mail

.....

***In case of absence:***

Technical Contact Person

.....

Telephone Number

.....

Fax Number

.....

Electronic Mail

.....

# 1. Questions to the company

## General Information

1. Are you interested in receiving the Invitation to Tender ?

Yes  No

2. Financial information

When established: .....

Registered capital: .....

Turnover in 1997: .....

Turnover in 1998: .....

Turnover in 1999: .....

Number of employees in 1999: .....

3. Did you already reply to a CERN call for tender or market survey?

Yes  No

If yes, specify for which product(s):

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## Qualification criteria

4. Does your company comply with the qualification criteria stipulated in this market survey?

Yes  No

If not, indicate which criterion(a) is (are) not satisfied and why:

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5. Does your product comply with all the technical requirements stipulated in this market survey?

Yes  No

If not, indicate which requirement(s) is (are) not satisfied and why:

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6. Is your company in a position to communicate promptly any change(s) in the product and its sub-components? (Qualification criterion 3)

Yes  No

7. Can you guarantee that pre-production and production modules will be identical?

Yes  No

8. Please indicate major customer references: (Qualification criterion 4)

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If your company has supplied MCM to CERN before, please indicate references:

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9. How many multi-chip modules do you produce yearly (please indicate substrate type)? (Qualification criterion 7)

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10. Do you have a registered Quality Assurance Plan? (Qualification criterion 9)

Yes  No

If yes, indicate which one:

.....  
.....  
11. In the event of being awarded a contract, does your company agree to procure ASIC chips from a CERN appointed supplier (Qualification criterion 10)

Yes  No

**Further Technical Information**

12. Do you have experience in the manufacturing of multi-chip modules for use in digital applications?

Yes  No

13. What kind of technical support can the company provide during the prototyping, pre-production and production phases?

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14. What is the maximum number of wire bonds per module in your past production?

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15. Give references of multi-chip modules of similar characteristics produced by you in the past.

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16. What is your monthly production capacity of ceramic modules?

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17. Do you have the equipment and experience to carry out the testing and qualification on the finished modules ?

Yes  No

If yes, give details (equipment, test procedures etc):

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**2. Questions from the company**

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*Date*

*Company seal and signature*