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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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[Continued on next page]

(54) Title: MAGNETIC FIELD SENSOR INTEGRATED CIRCUIT WITH INTEGRAL FERROMAGNETIC MATERIAL

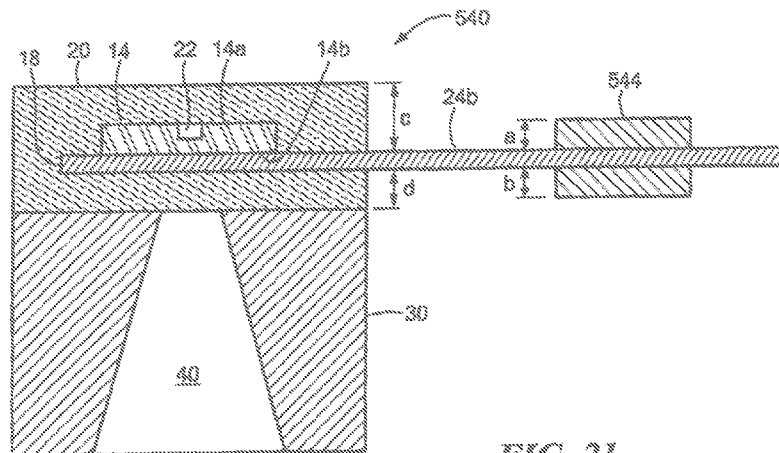


FIG. 21

(57) Abstract: A magnetic field sensor includes a lead frame, a die supporting a magnetic field sensing element and attached to the lead frame, a non-conductive mold material enclosing the die and a portion of the lead frame, and optionally a ferromagnetic mold material secured to a portion of the non-conductive mold material. The hard or soft ferromagnetic mold material may be tapered and includes a non-contiguous central region, as may contain a separately formed element. Embodiments include die up, lead on chip, and flip-chip arrangements, integrated components, such as capacitors, on the lead frame, and a bias magnet with a lateral channel. Optional features include a slotted lead frame, a molded suppression device, a passive device lead-coupled and a ferromagnetic bead. A coil may be secured to the non-conductive mold material and a passive component may be coupled across separated portions of a lead.





**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**(88) Date of publication of the international search report:**  
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- *with international search report (Art. 21(3))*

INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/025858

A. CLASSIFICATION OF SUBJECT MATTER  
INV. G01R33/00  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/141249 A1 (ARARAO VIRGIL [US] ET AL) 10 June 2010 (2010-06-10)	1-33, 38-74, 76-78, 80-85
A	abstract; figures 1A-1C, 4, paragraph [0036] - paragraph [0046] paragraph [0059] - paragraph [0063] -----	75,79,86
X	US 2011/127998 A1 (ELIAN KLAUS [DE] ET AL) 2 June 2011 (2011-06-02)  abstract; figure 4 paragraph [0041] - paragraph [0045] ----- -/--	1-11, 13-19, 28-37, 41-48

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search  17 September 2013	Date of mailing of the international search report  25/09/2013
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Böhm-Pélissier, A

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/025858

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 210 493 A (SCHROEDER THADDEUS [US] ET AL) 11 May 1993 (1993-05-11)  abstract; figure 4 column 6, line 53 - column 7, line 54 -----	1-19, 28-33, 41-48
X	US 2010/295140 A1 (THEUSS HORST [DE] ET AL) 25 November 2010 (2010-11-25)  paragraph [0031] - paragraph [0036] -----	1-19, 28-33, 41-48
A	US 2006/038560 A1 (KURUMADO NORIHIRO [JP]) 23 February 2006 (2006-02-23) paragraph [0029] - paragraph [0030] paragraph [0009] - paragraph [0014] paragraph [0028] -----	22-27, 66-71
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A	JP 2001 116815 A (DENSO CORP) 27 April 2001 (2001-04-27) -----	22-27, 66-71
X	US 2007/170533 A1 (DOOGUE MICHAEL C [US] ET AL) 26 July 2007 (2007-07-26) abstract; figures 1, 1A,6,7,8 paragraph [0036] - paragraph [0058] paragraph [0128] -----	34-37
X	US 2004/155644 A1 (STAUTH JASON [US] ET AL) 12 August 2004 (2004-08-12) abstract; figures 8,9 paragraph [0123] - paragraph [0135] -----	34-37
X	US 2004/207398 A1 (KUDO TAKAHIRO [JP] ET AL) 21 October 2004 (2004-10-21) abstract; figures 1,2 paragraph [0034] - paragraph [0037] -----	76-78, 80-83
X	US 2001/030537 A1 (HONKURA YOSHINOBU [JP] ET AL) 18 October 2001 (2001-10-18) abstract; figures 6-9 paragraph [0091] - paragraph [0096] -----	76-78, 80-83

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2013/025858

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/025858

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2013/025858
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**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-19, 28-33, 41-48

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where the leadframe is overmolded by a ferromagnetic material having a tapered surface.

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2. claims: 20-27, 55, 56, 66-71

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where the leadframe comprises a capacitor or wherein the lead frame comprises a slot.

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3. claims: 34-37

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where the sensor die is overmolded by a ferromagnetic material.

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4. claims: 38-40, 49-54, 57-65

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where a magnet is attached to the lead frame and a channel extending from a central region or where a separately formed element is disposed in and secured to the central region of the ferromagnetic mold material or where a ferromagnetic suppression device is attached to the lead frame.

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5. claims: 72-75

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where at least one ferromagnetic bead is coupled to at least one of the plurality of leads.

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6. claims: 76-83

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where a conductive coil is secured to the non-conductive mold material.

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7. claims: 84-86

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

These claims are related to a magnetic sensor with an overmolded die and an overmolded leadframe where a passive component is coupled between the end of the first lead portion and the end of the second lead portion.

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