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AO, AT, AU, AZ, BA, BB, BG, BH, 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, 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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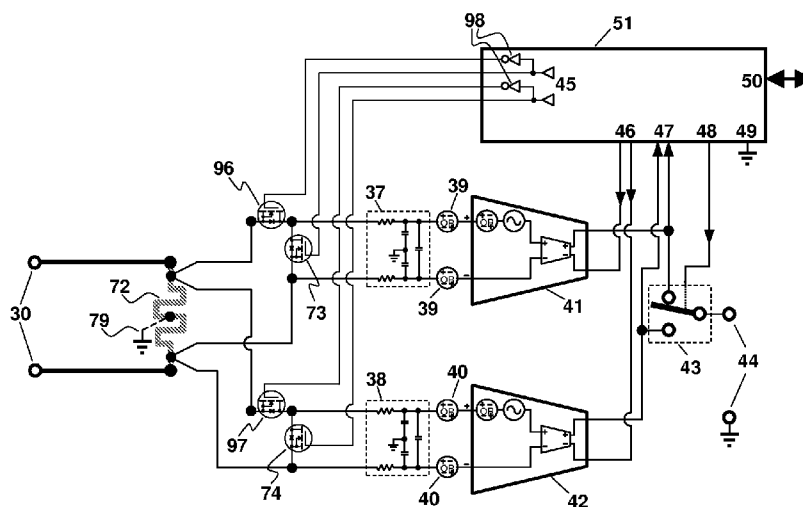


Figure 7

(57) Abstract: An apparatus and method make use of a single shunt and two or more instrumentation amplifiers, switchably measuring voltages at the shunt. This permits current measurement. At times each instrumentation amplifier has its input shorted, which permits zeroing out many sources of offset in the signal path of that amplifier. Dynamic range is several orders of magnitude better than known current measurement approaches, permitting coulometry.

A. CLASSIFICATION OF SUBJECT MATTER**G01R 19/165(2006.01)i**

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 19/165; G01R 15/12; G01R 15/08; G01R 19/00; G01R 27/08; G01R 15/09

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: amplifier, first, second, impedance, switch

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2003-0025514 A1 (MICHAEL J. BENES) 06 February 2003 See abstract, claims 1-9 and figures 1-4	1-23
A	US 2011-0025299 A1 (MARKO VULOVIC et al.) 03 February 2011 See abstract, claims 1-20 and figure 1	1-23
A	US 2009-0273338 A1 (WAYNE C. GOEKE et al.) 05 November 2009 See abstract and claims 1-13	1-23
A	US 6617838 B1 (EVALDO M. MIRANDA et al.) 09 September 2003 See abstract and claims 1-11	1-23

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

09 AUGUST 2012 (09.08.2012)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003-0025514 A1	06.02.2003	US 6603301 B2	05.08.2003
US 2011-0025299 A1	03.02.2011	None	
US 2009-0273338 A1	05.11.2009	US 7923985 B2	12.04.2011
US 6617838 B1	09.09.2003	None	