AKM Semiconductor Inc

www.akm.com

AKM Magnetic Sensors

Engineering Development Kits

Demonstration Modules

Application Case Studies

Lou Law

May 2011

GMW Associates www.gmw.com 650-802-8292

AKM Engineering Development Kits and Product Support Documents

1 - AKM Hall Element KITs

- **AN_161KITs**
- **AN_160KIT Universal Hall Interface Amplifier**

2 - Gapped Core Current Sensor KITs using the AKM EQ-73XL Series Linear ICs

- **AN_130KIT EQ-730L**
- **AN_131KIT EQ-731L**
- **AN_135KIT EQ-733L**
- **AN_136KIT EQ-733L**

3 - CQ-121/131 Series Current Sensors KITS

- **AN_165KIT**

4 - CQ-20XX Series Current Sensors KITS

- **AN_170KIT**

5 - EM3242 Non-Contact Angle Sensor IC KITs

- **AN_133KIT**
- **Reference Design RD101-EM3242**
- **AN_134KIT**
- **Reference Design RD102-EM3242**

6 - Case Studies of Application using the AKM sensors

- **AKMCS-001 Non Contact Remote ON-OFF**
- **AKMCS-002 Flow Meter using EM3242 Angle Sensor**
- **AKMCS-003- Flow Meter using AKM Encoder IC's**
- **AKMCS-004 Accurate Position Sensing using AKM Hall Switches**

7 - Demonstrators

- **AK8775/6 Encoder ICs**

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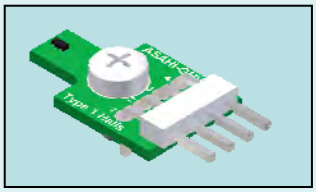
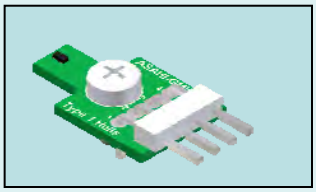
Type 1 PCB



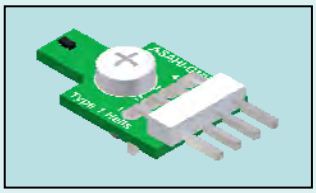
HG-0111, HG-0112, HG-0113, HG-0114, HG-0115, HS-0111, HQ-0111

Type 2 PCB



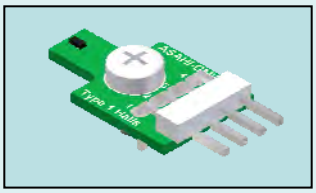
HW-105A, HW-108A, HW-105C, HW-108C

Type 3 PCB



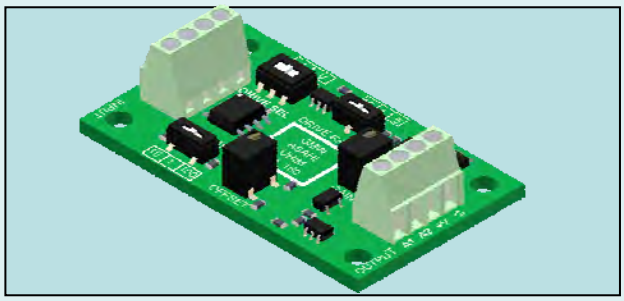
HG-106C, HG-106A, HG-176A, HG-186A, HG-166A, HZ-116C

Type 4 PCB



HW-101A, HW-102A

AN_160KIT (UHIM)



UHIM Features

- Terminals for all I/O connections
- User Selectable I/V drive levels
- User Selectable I/V Ranges
- User Selectable Coarse Gain
- Fine Gain Adjustment
- Offset Adjustment
- Compatible with Types 1-4 PCBs and SIP packages

ASAHI Hall Element Evaluation Boards and AN_160KIT, Universal Hall Interface Module

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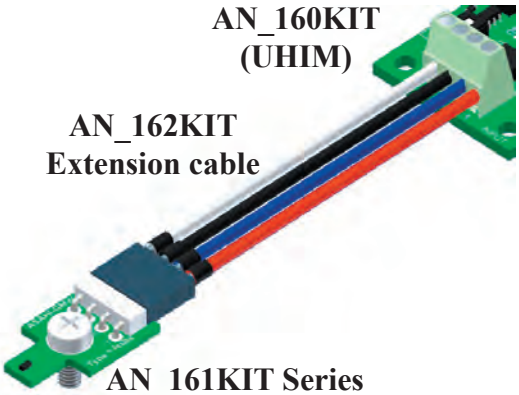
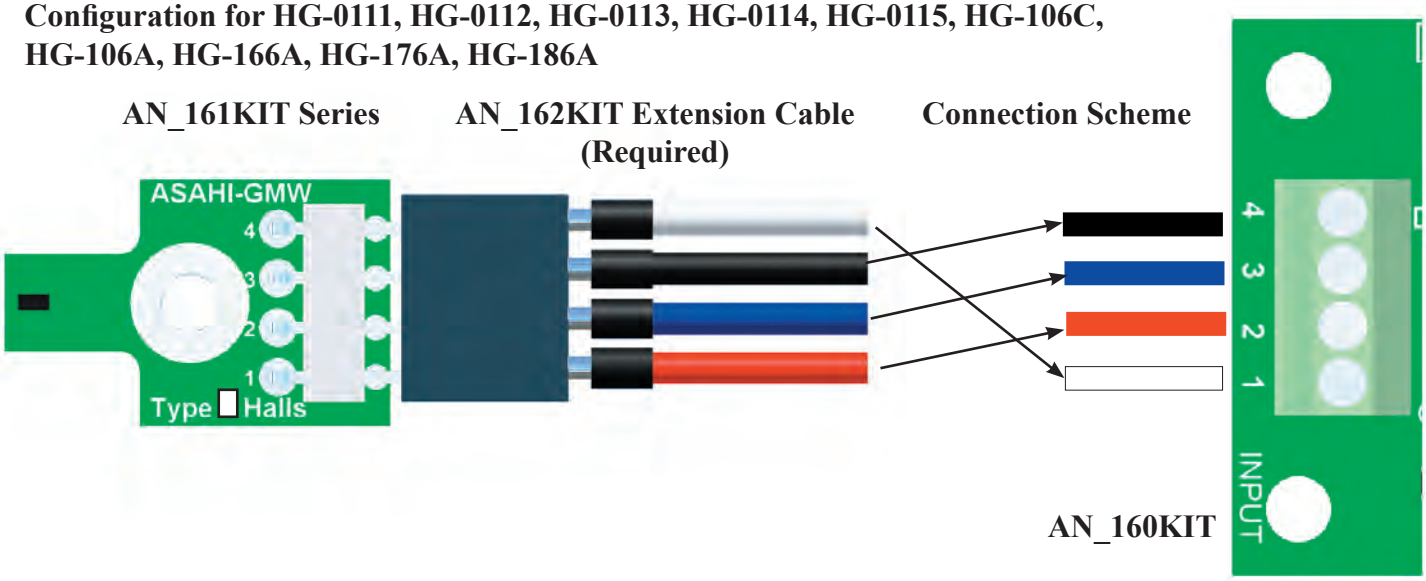
Asahi Hall Element Test Kits - AN_161KIT Series

DESCRIPTION

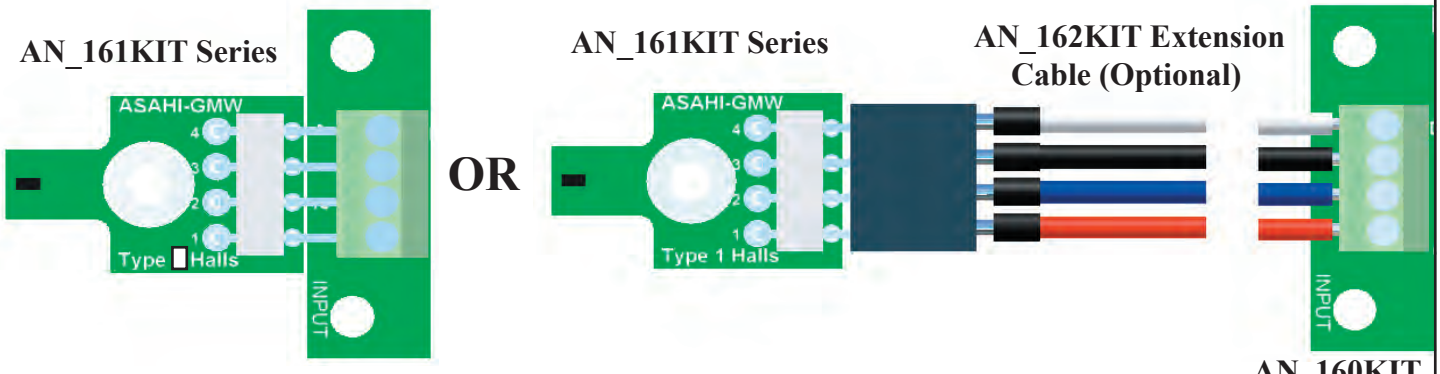
The AN_161KIT series of kits are PCB assemblies which provide an easy means to evaluate the Asahi Hall elements for magnetic field, electric current or position sensing applications. These kits can be used independently by themselves or with the GMW AN_160KIT, Universal Hall Interface Module (UHIM). There are two basic connection schemes depending on the kit part number as shown below. See the AN_160KIT specification sheet for details on the use of these kits with the UHIM.



Configuration for HG-0111, HG-0112, HG-0113, HG-0114, HG-0115, HG-106C, HG-106A, HG-166A, HG-176A, HG-186A



Configuration for HW-0105A, HW-0105C, HW-101A, HW-108A, HW-108C, HQ-0111, HS-0111



Revision Date: Feb 17,2011

Universal Hall Interface Module - AN_160KIT

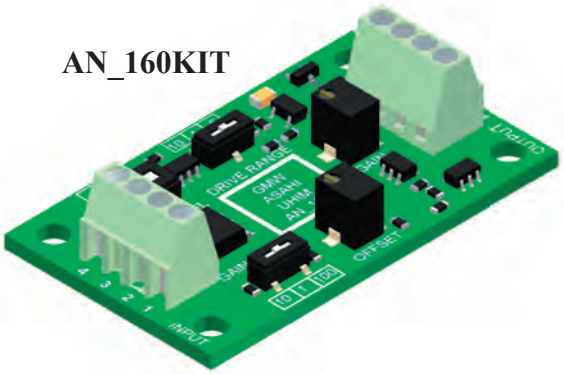
DESCRIPTION

The AN_160KIT is a Universal Hall Interface Module (UHIM) which provides an easy means to evaluate the Asahi Hall elements for magnetic field, electric current or position sensing applications.

The UHIM consists of a differential amplifier, a voltage drive circuit for Hall elements requiring a voltage drive, a current drive circuit for Hall elements requiring current drive, and two analog output circuits to provide the standard 2.5V+/- 2.5V signal and a 1.5V+/- 1.5V signal for 0-3V input level A/D circuits.

The kit provides selector switches to configure the UHIM to optimize the parameters for the various Asahi Hall elements and both a gain adjustment potentiometer and an offset adjustment potentiometer. The UHIM will interface with GWM's Asahi element test PCB kits (AN_161 series) and the SIP element packages

AN_160KIT



Features:

- **Terminal strips for all input/output connections**
- **User selectable current drive or voltage drive**
- **User selectable current or voltage drive ranges (10/1/5) mA or volts**
- **User selectable coarse gain ranges (1-10,10-100,100-1000)**
- **Fine Gain adjustment (1-10X)**
- **Offset adjustment**
- **Two Analog outputs (2.5+/-2.5V and 1.5V+/- 1.5V for 0-3V ADCs)**
- **Compatible with all Asahi/GMW Element test PCB KITS and SIP devices**

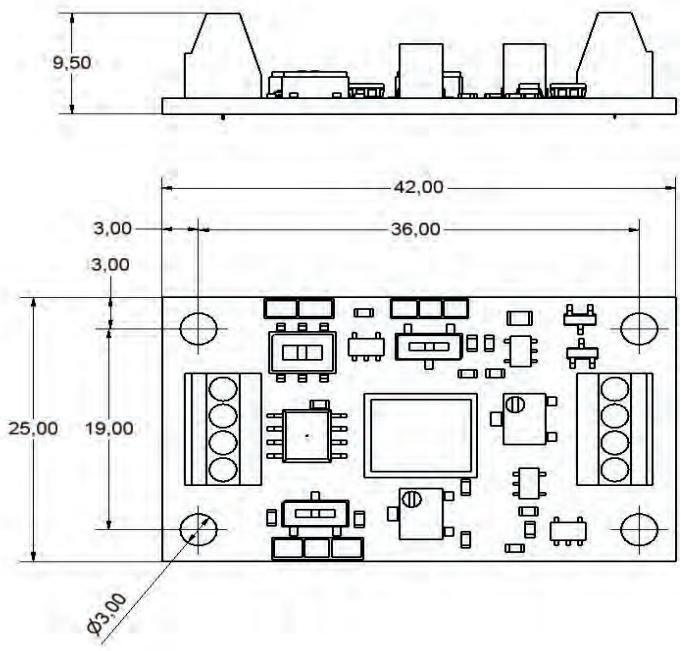


Fig 1. AN_160KIT Outline

Revision Date: Feb 17, 2011

SPECIFICATIONS

Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
T_{STG}	Storage Temperature	-40		100	°C	
T_A	Ambient Temperature	-10		85	°C	With power applied
V_{DD}	Supply Voltage	-0.5		+16.0	V	

Recommended Operating Conditions

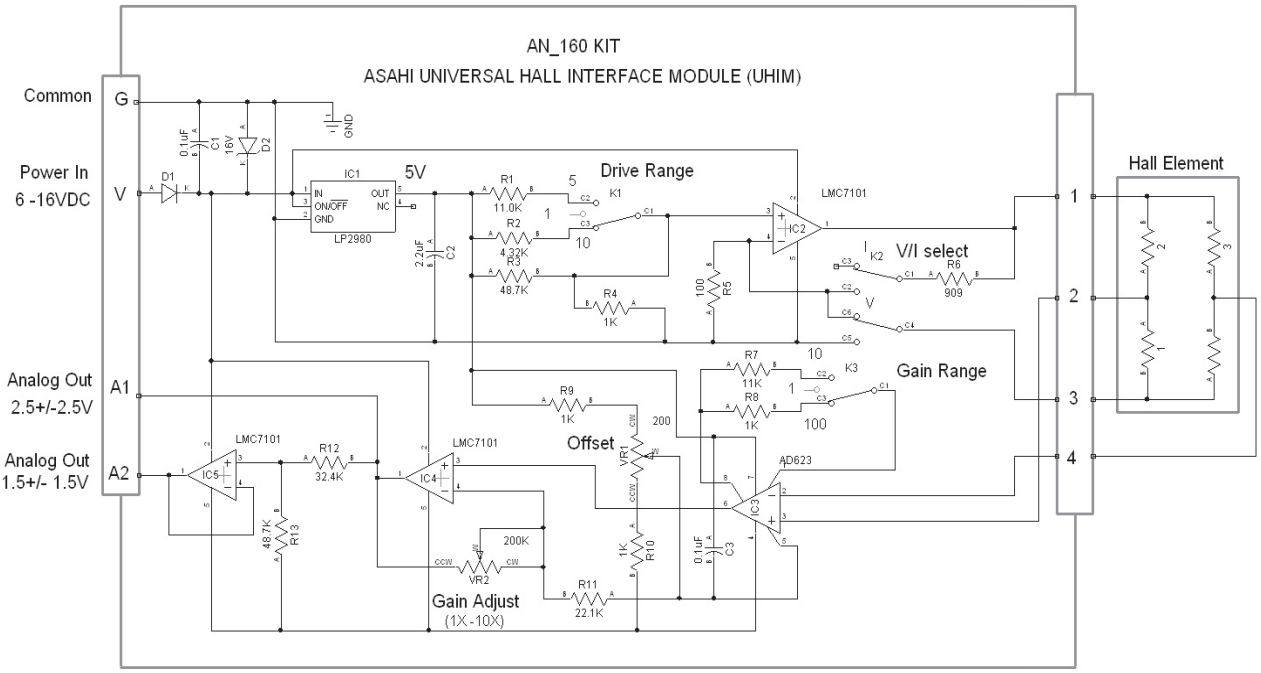
Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
V_{DD}	Supply Voltage	5.5	5.5	16	V	
A1	Analog Output 1	0.05	2.5	4.95	V	
A2	Analog Output 2	0.05	1.5	2.95	V	For 0-3 V A/D's

Table 2. Asahi Hall Element Test Kit Selection and UHIM Configuration table

Hall Elements	Element Kit Type	Hall Element Kit P/N (Ordered separately)	Extension Cable	UHIM Configuration							
				Drive Select		Drive Range (V) or (mA)			Coarse Gain Range		
				I (current)	V (voltage)	10	1	5	10	1	100
HG-0111, HG-0112	1	AN_161-xx-xxxx (1)	Required	X			X		X	X	X
HG-0114, HG-0115	1	AN_161-xx-xxxx (1)	Required	X			X		X	X	X
HS-0111	1	AN_161-xx-xxxx (1)	Optional		X		X		X	X	X
HG-0113	1	AN_161-xx-xxxx (1)	Required	X				X	X	X	X
HQ-0111	1	AN_161-xx-xxxx (1)	Optional		X			X	X	X	X
HW-105A, HW-108A, HW-105C, HW-108C	2	AN_161-xx-xxxx (1)	Optional		X		X		X	X	X
HG-106C, HG-106A	3	AN_161-xx-xxxx (1)	Required	X		X			X	X	X
HG-176A, HG-186A	3	AN_161-xx-xxxx (1)	Required	X			X		X	X	X
HG-166A	3	AN_161-xx-xxxx (1)	Required	X				X	X	X	X
HW-101A	4	AN_161-xx-xxxx (1)	Optional		X		X		X	X	X
HW-300B, HW-302B, HW-322B	N/A	SIP (no kit required)	Optional		X		X		X	X	X
HG-302C, HG-302A	N/A	SIP (no kit required)	Optional	X		X			X	X	X

Note: 1) Example: For a kit with the HG-0111 device the Hall element kit number would be AN_161-HG-0111

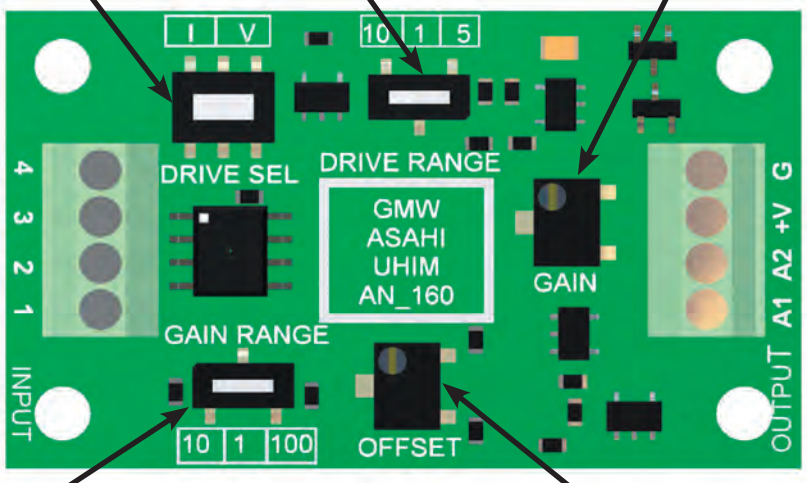
Fig. 2 Schematic, AN_160KIT



Current Drive or Voltage Drive Select switch

Drive Range Select switch- When I/V Sel Switch is in I, range is 10mA,1mA or 5mA . When I/V Sel switch is in V, range is 10V, 1V or 5V

Analog Output Fine Gain adjustment 11 turn potentiometer



Hall Element Input or AN_161KIT Connection

Common

Power Input 5.5V-16V

Analog Output 1.5+/-1.5V

Analog Output 2.5+/-2.5V

Analog Outputs coarse Gain Range selection switch - 10X, 1X, 100X

Analog Outputs Offset voltage adjustment- 11 turn potentiometer

Fig. 3 - AN_160KIT Controls and Interconnect Layout

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Fig 4 AN_160KIT UHIM with direct connection to the AN_161 Hall Element Kit

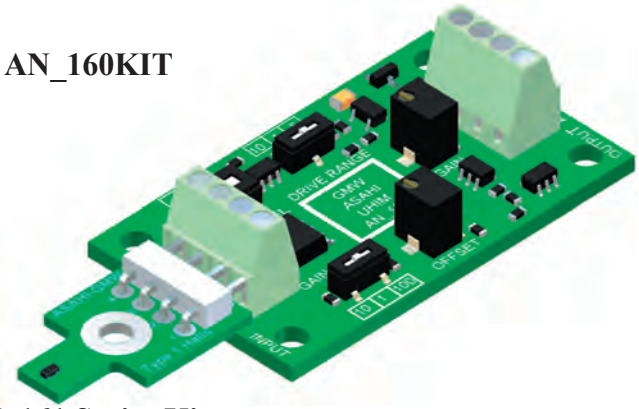


Fig 5 AN_160KIT UHIM with direct Hall Element SIP package connection

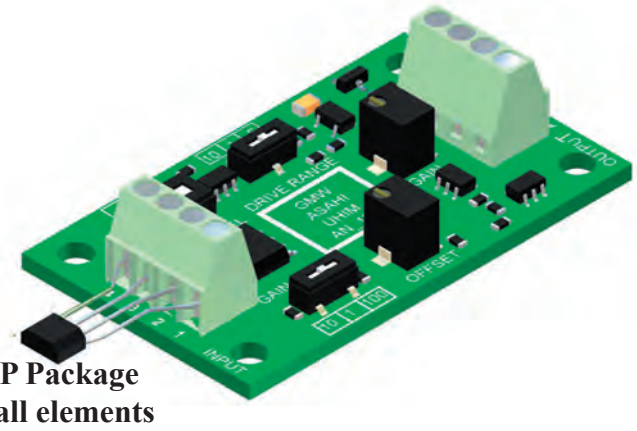


Fig 6 AN_160KIT UHIM with direct connection to the AN_161 Hall Element Kit via AN_162KIT extension cable

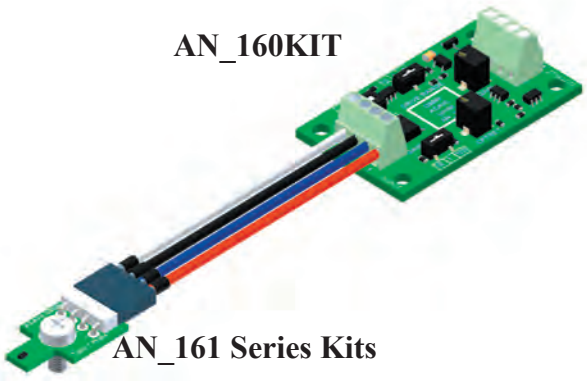


Fig 7 AN_162KIT Extension Cable for AN_160KIT and AN_161 Hall Element Series Kit

Application Notes:

Connect the Hall element kit (AN_161-xx-xxx) or SIP Hall element to the AN_160KIT as shown in the above Figures (4 thru 7).

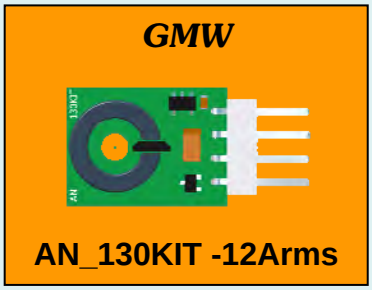
Configure the AN_160KIT Module "Drive Sel" and "Drive Range" for the device being tested per the criteria shown in Table 2

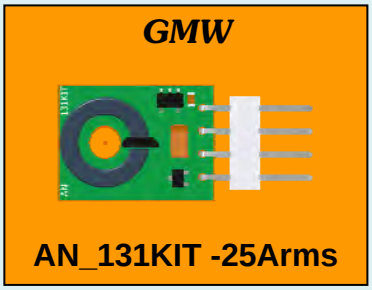
Apply power (5.5V to 16VDC) to the terminals shown in Figure 3

Monitor the output (s) shown in Fig 3 with respect to common

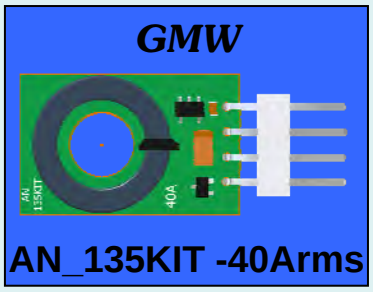
Set the "GAIN RANGE" switch, and adjust the "GAIN" and "OFFSET" potentiometers as needed

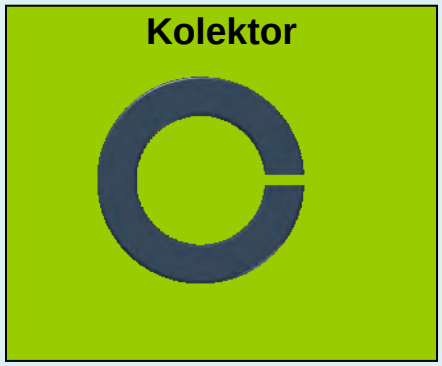
(P/N T22G-10-06-04-1.25)



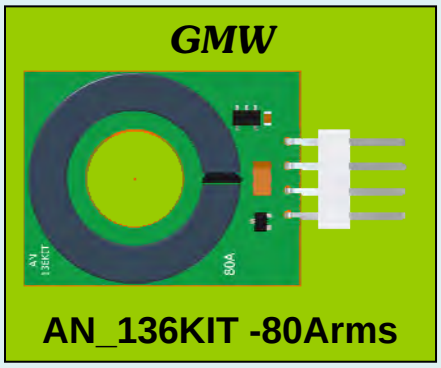


(P/N T22G-14-09-05-1.25)





(P/N T22G-22-14-7-1.25)



Core Selections for Nom Hall IC Sensitivity @ 5V

IC	Peak Current (A)	Current Resolution (mAp-p)	Kolector Magma (mm)		
			OD	ID	HT
EQ-730L	17	7	10.0	6.0	4.0
EQ-731L	35	13			
EQ-732L	55	22	14.0	9.0	5.0
EQ-733L	110	44	22.1	13.7	7.0

AKM

Features

- Low Noise-Wide Dynamic Range
- 3 to 5.5V Operation
- 4 Sensitivity ranges (20,40,65,130 mV/mT)
- SIP and SMD Packages
- Fast response time<2.5us
- DC to 100kHz

Gapped Core Current Sensors Kits using Asahi Low Noise Linear Hall Effect Sensor IC

GMW Associates www.gmw.com 650-802-8292

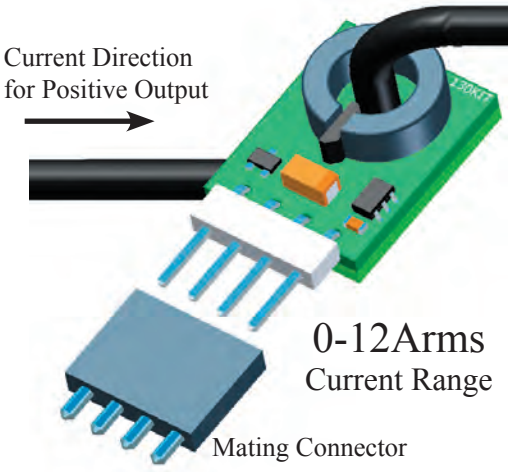
AN_130KIT - Asahi EQ-730L Hall Sensor
Gapped Core, Open Loop, Current Sensor Application

General Description

The AN_130KIT provides an easy method of evaluating the Asahi EQ-730L Linear Hall sensor IC in a “gapped core” current sensor application. The AN_130KIT includes the Asahi EQ-730L linear IC mounted in the nominal 1.25mm wide gap cut into a 10mm x 6 mm x 4mm Ferrite core. This configuration produces a nominal output sensitivity of 120mV/A. The full scale current range is 12Arms or 17A peak. The kit includes a +5V regulator, however the circuit will work down to 2.7VDC. With the input voltage below 5V, the Hall IC supply is no longer regulated and the sensitivity, supply current and full scale output range will reduce by an amount directly proportional to the supply voltage. For example; at 3V, the sensitivity is 3/5 of 120mV/A will be equal to 73mV/A

The Asahi EQ-730L has a very fast response time, < 5uS, thereby making if very useful for over current applications. The Asahi EQ-730L broadband output noise characteristic is low, < 5mVpp, to give an operating range of about 2000mV/2.5mV or about 800:1.

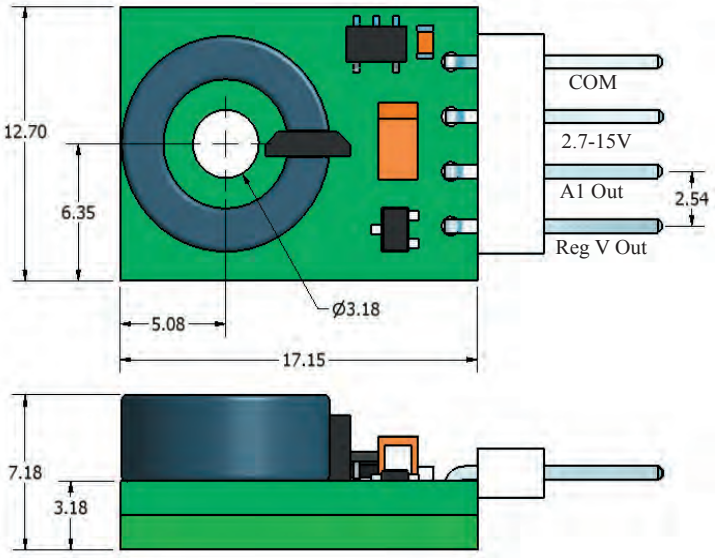
Included in the kit is a mating connector



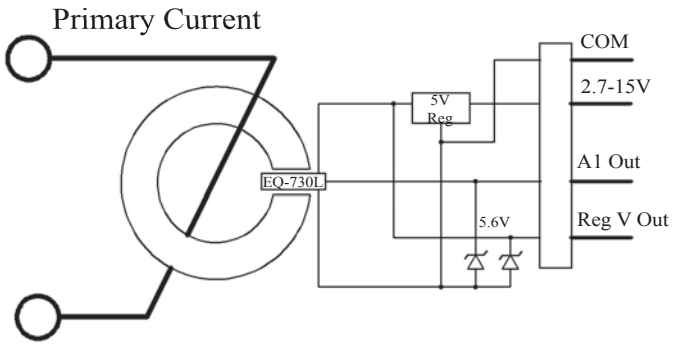
AN_130KIT with mating connector

Features

Measures AC or DC currents in wires up to 14AWG
Nominal Sensitivity: 120 ±35 mV/A for 5V Supply and 73 ±22 mV/A for 3V Supply
(EQ-730L Magnetic Sensitivity of 130 ±30 mV/mT)
Nominal Quiescent Output Voltage: 2.5V+/- 0.20V @ Iprimary = 0A
Fast response time: <5uS
Wide bandwidth: DC to 300kHz (-3dB)
Low noise:< 5mVpp
Large Dynamic range > 800:1
Full scale output linear of 2.5V+/- 2.0V (With input supply voltage of 5.0 to 15VDC)
Supply current: ≈ 8mA
Supply voltage range of 2.7V to 15V (Below 5.0V, the voltage to the EQ-730L is unregulated)
Galvanic isolation between primary conductor and sensor
Interface Connector - 4 Pin 0.100” centers (Mating connector included)
Bi-directional sensing
Regulated Voltage Output (+5V) Pin (available for external use- up to 20mA)



AN-130KIT Outline Drawing (all dimensions in mm



AN_130KIT Electrical Block Diagram

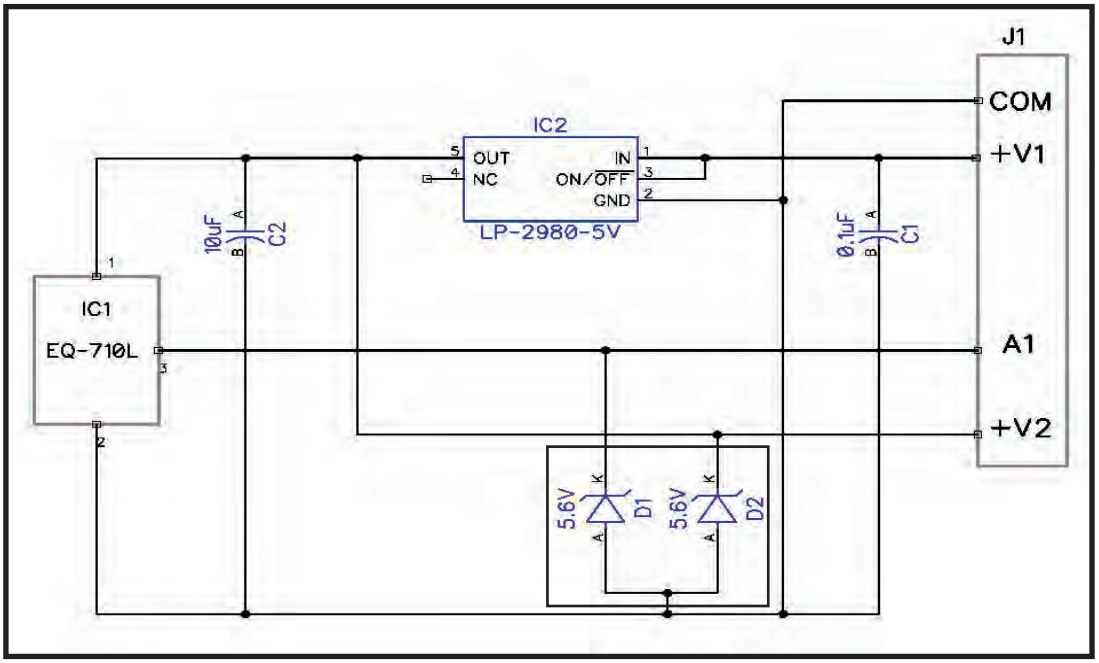
References:

Hall IC Specification EQ-730L

Ferrite Core Specification T 22G 10 06 04-02

Revision Date: Feb 17, 2011

Schematic, AN_130KIT



Parts List, AN_130KIT

Item	Qty	P/N	Title	Reference(m)	Vendor	Vendor P/N
1	1	12900-2426-0	IC, Linear Hall Effect, +/- 130mV/mT, EQ-710L	IC1	GMW Associates	Asahi EQ-710L
2	1	12900-2413-0	IC REG LDO MICROPOWER SOT23-5	IC2	Digi-Key Corporation	LP2980IM5-5.0CT-ND
3	1	12900-2201-3	CAP CER .10UF 50V Y5V 0603	C1	Digi-Key Corporation	445-1324-2-ND
4	1	12900-2302-0	Diode, Zener, 5.6V, SMD	D1/D2	Digi-Key Corporation	AZ23C5V6-FDITR-ND
5	1	12900-2213-0	CAP TANTALUM 10UF 6.3V 10% SMD	C2	Digi-Key Corporation	495-2180-1-ND
6	1	12900-2709-0	Conn Header 4POS 0.100 R/A Tin	J1	Digi-Key Corporation	WM6004-ND
7	1	12900-2812-0	Core, Ferite, 10mm x 6 mm x 4mm 1.25mm Gap	T1	Ceramic Magnnetics, Inc.	T22G 10 06 04-02

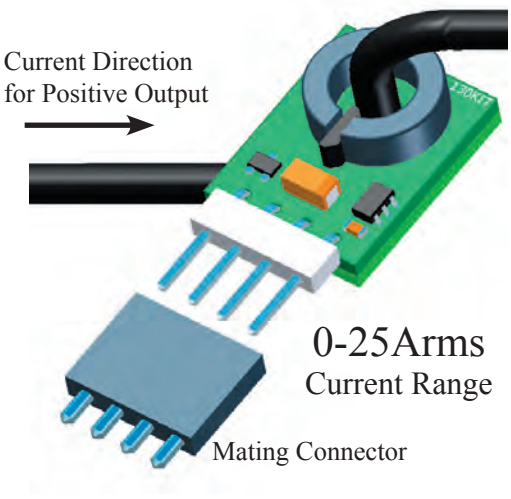
AN_131KIT - Asahi EQ-731L Hall Sensor
Gapped Core, Open Loop, Current Sensor Application

General Description

The AN_131KIT provides an easy method of evaluating the Asahi EQ-731L Linear Hall sensor IC in a "gapped core" current sensor application. The AN_131KIT includes the Asahi EQ-731L linear IC mounted in the nominal 1.25mm wide gap cut into a 10mm x 6 mm x 4mm Ferrite core. This configuration produces a nominal output sensitivity of 60mV/A. The full scale current range is 25Arms or 35A peak. The kit includes a +5V regulator, however the circuit will work down to 2.7VDC. With the input voltage below 5V, the Hall IC supply is no longer regulated and the sensitivity, supply current and full scale output range will reduce by an amount directly proportional to the supply voltage. For example; at 3V, the sensitivity is 3/5 of 60mV/A will be equal to 36mV/A

The Asahi EQ-731L has a very fast response time, < 5uS, thereby making if very useful for over current applications. The Asahi EQ-731L broadband output noise characteristic is low, < 5mVpp, to give an operating range of about 2000mV/2.5mV or about 800:1.

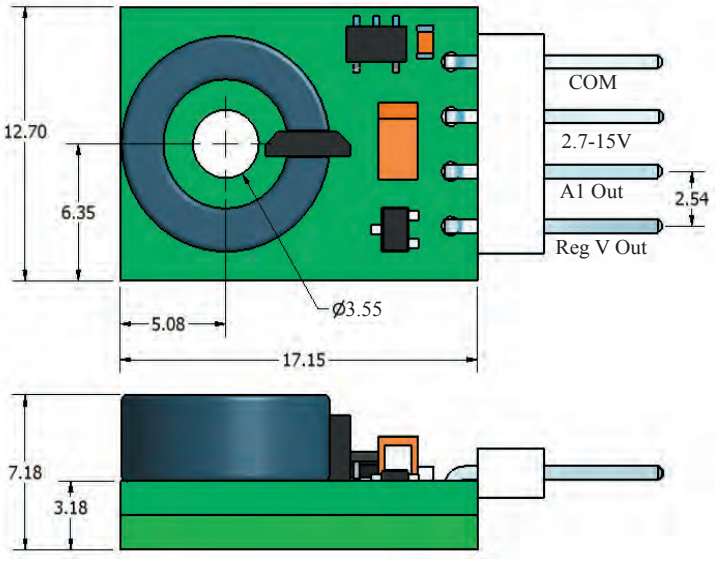
Included in the kit is a mating connector



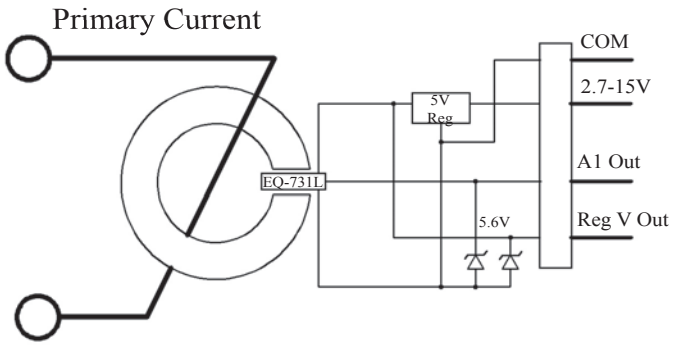
AN_131KIT with mating connector

Features

Measures AC or DC currents in wires up to 12AWG
Nominal Sensitivity: 63 ±20 mV/A for 5V Supply and 36 ±12 mV/A for 3V Supply
(EQ-731L Magnetic Sensitivity of 65 ±15 mV/mT
Nominal Quiescent Output Voltage: 2.5V+/- 0.15V @ Iprimary = 0A
Fast response time: <5uS
Wide bandwidth: DC to 300kHz (-3dB)
Low noise:< 5mVpp
Large Dynamic range > 800:1
Full scale output linear of 2.5V+/- 2.0V (With input supply voltage of 5.0 to 15VDC)
Supply current: ≈ 8mA
Supply voltage range of 2.7V to 15V (Below 5.0V, the voltage to the EQ-731L is unregulated)
Galvanic isolation between primary conductor and sensor
Interface Connector - 4 Pin 0.100" centers (Mating connector included)
Bi-directional sensing
Regulated Voltage Output (+5V) Pin (available for external use- up to 20mA)



AN-131KIT Outline Drawing (all dimensions in mm



AN_131KIT Electrical Block Diagram

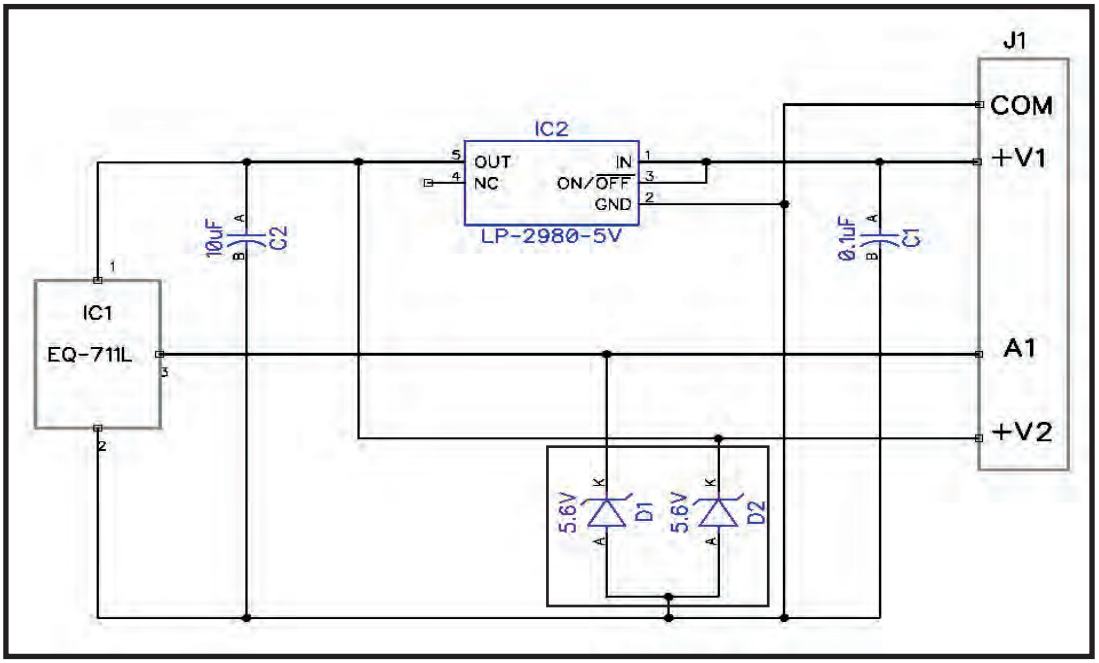
References:

Hall IC Specification EQ-731L

Ferrite Core Specification T 22G 10 06 04-02

Revision Date: Feb 17, 2011

Schematic, AN_131KIT



Parts List, AN_131KIT

Item	Qty	P/N	Title	Reference(m)	Vendor	Vendor P/N
1	1	12900-2427-0	IC, Linear Hall Effect, +/- 69mV/mT, EQ-711L	IC1	GMW Associates	EQ-711L
2	1	12900-2413-0	IC REG LDO MICROPOWER SOT23-5	IC2	Digi-Key Corporation	LP2980IM5-5.0CT-ND
3	1	12900-2201-0	CAP .1UF 50V CERAMIC X7R 0805	C1	Digi-Key Corporation	PCC1840TR-ND
4	1	12900-2302-0	Diode, Zener, 5.6V, SMD	D1/D2	Digi-Key Corporation	AZ23C5V6-FDITR-ND
5	1	12900-2213-0	CAP TANTALUM 10UF 6.3V 10% SMD	C2	Digi-Key Corporation	495-2180-1-ND
6	1	12900-2709-0	Conn Header 4POS 0.100 R/A Tin	J1	Digi-Key Corporation	WM6004-ND
7	1	12900-2812-0	Core, Ferite, 10mm x 6 mm x 4mm 1.25mm Gap	T1	Ceramic Magnnetics, Inc.	T22G 10 06 04-02

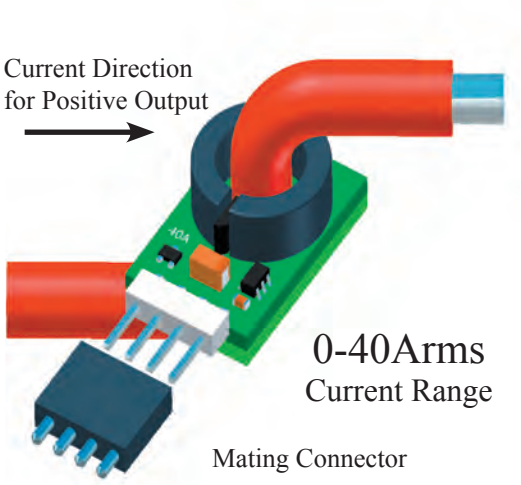
AN_135KIT - Asahi EQ-732L Hall Sensor
Gapped Core, Open Loop, Current Sensor Application

General Description

The AN_135KIT provides an easy method of evaluating the Asahi EQ-732L Linear Hall sensor IC in a "gapped core" current sensor application. The AN_135KIT includes the Asahi EQ-732L linear IC mounted in the nominal 1.25mm wide gap cut into a 14mm x 9 mm x 5mm Ferrite core. This configuration produces a nominal output sensitivity of 37mV/A. The full scale current range is 40Arms or 57A peak. The kit includes a +5V regulator, however the circuit will work down to 2.7VDC. With the input voltage below 5V, the Hall IC supply is no longer regulated and the sensitivity, supply current and full scale output range will reduce by an amount directly proportional to the supply voltage. For example; at 3V, the sensitivity is 3/5 of 37mV/A will be equal to 22mV/A

The Asahi EQ-732L has a very fast response time, < 5uS, thereby making if very useful for over current applications. The Asahi EQ-732L broadband output noise characteristic is low, < 5mVpp, to give an operating range of about 2000mV/2.5mV or about 800:1.

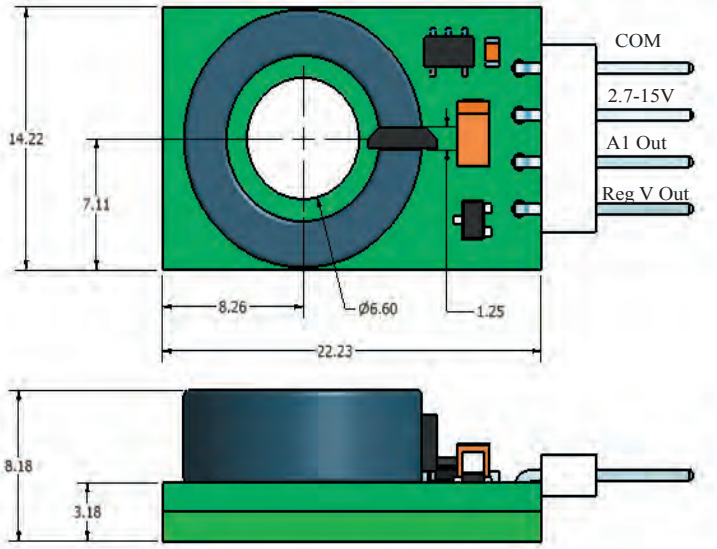
Included in the kit is a mating connector



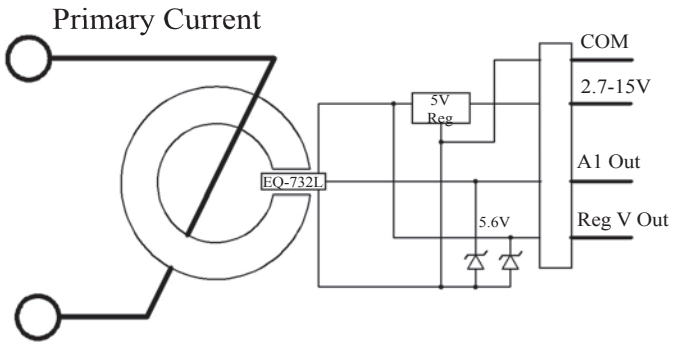
AN_135KIT with mating connector

Features

Measures AC or DC currents in wires up to 8AWG
Nominal Sensitivity: 37 ±10 mV/A for 5V Supply and 22 ±7 mV/A for 3V Supply
(EQ-732L Magnetic Sensitivity of 40 ±10 mV/mT
Nominal Quiescent Output Voltage: 2.5V+/- 0.10V @ Iprimary = 0A
Fast response time: <5uS
Wide bandwidth: DC to 300kHz (-3dB)
Low noise:< 5mVpp
Large Dynamic range > 800:1
Full scale output linear of 2.5V+/- 2.0V (With input supply voltage of 5.0 to 15VDC)
Supply current: ≈ 8mA
Supply voltage range of 2.7V to 15V (Below 5.0V, the voltage to the EQ-732L is unregulated)
Galvanic isolation between primary conductor and sensor
Interface Connector - 4 Pin 0.100" centers (Mating connector included)
Bi-directional sensing
Regulated Voltage Output (+5V) Pin (available for external use- up to 20mA)



AN-135KIT Outline Drawing (all dimensions in mm



AN_135KIT Electrical Block Diagram

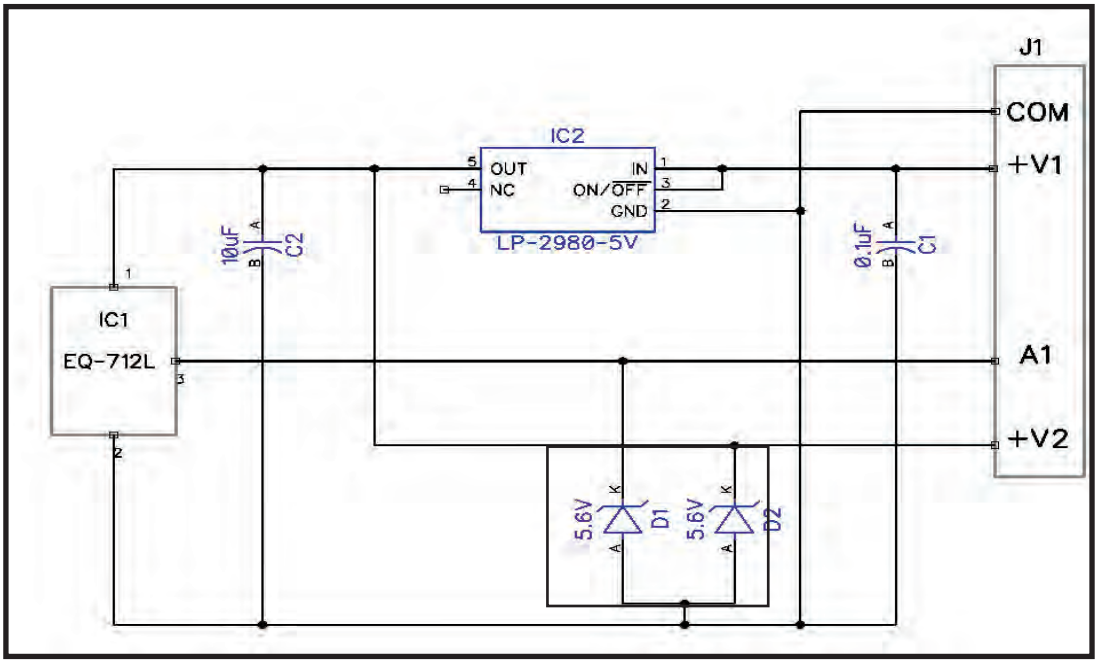
References:

Hall IC Specification EQ-732L

Ferrite Core Specification T 22G 14 09 05-02

Revision Date: Feb 17,2011

Schematic, AN_135KIT



Parts List, AN_135KIT

Item	Qty	Title	Reference(m	Vendor	Vendor P/N
1	1	IC, Linear Hall Effect, +/- 40mV/mT, EQ-712L	IC1	GMW Associates	EQ-712L
2	1	IC REG LDO MICROPOWER SOT23-5	IC2	Digi-Key Corporation	LP2980IM5-5.0CT-ND
3	1	CAP .1UF 50V CERAMIC X7R 0805	C1	Digi-Key Corporation	PCC1840TR-ND
4	1	Diode, Zener, 5.6V, SMD	D1/D2	Digi-Key Corporation	AZ23C5V6-FDITR-ND
5	1	CAP TANTALUM 10UF 6.3V 10% SMD	C2	Digi-Key Corporation	495-2180-1-ND
6	1	Conn Header 4POS 0.100 R/A Tin	J1	Digi-Key Corporation	WM6004-ND
7	1	Core, Ferite, 14mm x 9 mm x 5mm 1.25mm Gap	T1	Ceramic Magnnetics, Inc.	T 22G 14 09 05-02

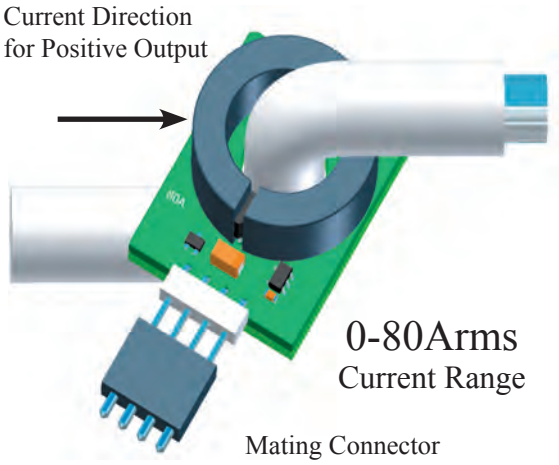
AN_136KIT - Asahi EQ-733L Hall Sensor
Gapped Core, Open Loop, Current Sensor Application

General Description

The AN_136KIT provides an easy method of evaluating the Asahi EQ-733L Linear Hall sensor IC in a "gapped core" current sensor application. The AN_136KIT includes the Asahi EQ-733L linear IC mounted in the nominal 1.25mm wide gap cut into a 22mm x 14 mm x 7mm Ferrite core. This configuration produces a nominal output sensitivity of 37mV/A. The full scale current range is 40Arms or 57A peak. The kit includes a +5V regulator, however the circuit will work down to 2.7VDC. With the input voltage below 5V, the Hall IC supply is no longer regulated and the sensitivity, supply current and full scale output range will reduce by an amount directly proportional to the supply voltage. For example; at 3V, the sensitivity is 3/5 of 37mV/A will be equal to 22mV/A

The Asahi EQ-733L has a very fast response time, < 5uS, thereby making if very useful for over current applications. The Asahi EQ-733L broadband output noise characteristic is low, < 5mVpp, to give an operating range of about 2000mV/2.5mV or about 800:1.

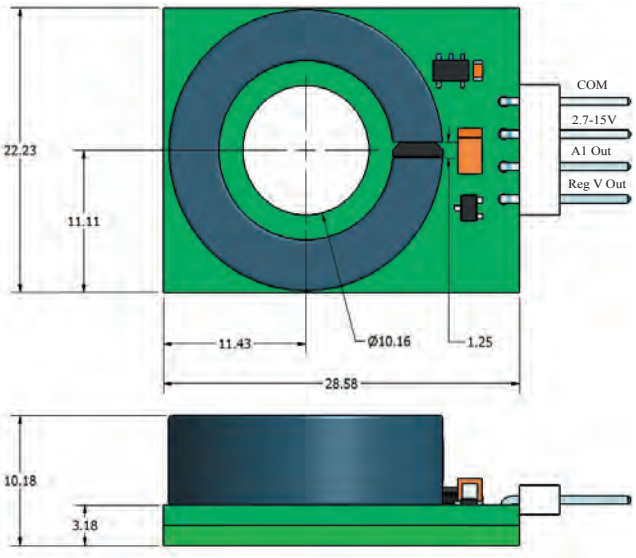
Included in the kit is a mating connector



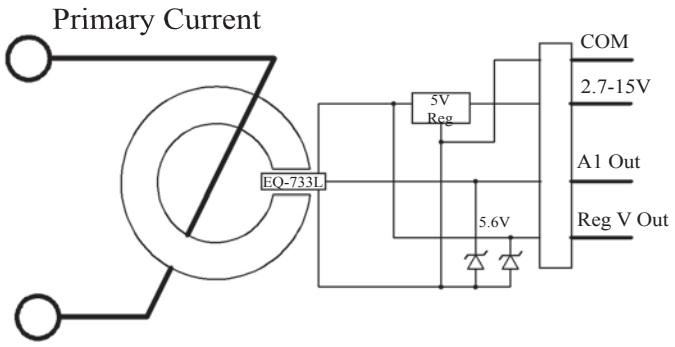
AN_136KIT with mating connector

Features

Measures AC or DC currents in wires up to 4AWG
Nominal Sensitivity: 18 ±6 mV/A for 5V Supply and 11 ±3.5mV/A for 3V Supply
(EQ-733L Magnetic Sensitivity of 20 ±5 mV/mT
Nominal Quiescent Output Voltage: 2.5V+/- 0.05V @ Iprimary = 0A
Fast response time: <5uS
Wide bandwidth: DC to 300kHz (-3dB)
Low noise:< 5mVpp
Large Dynamic range > 800:1
Full scale output linear of 2.5V+/- 2.0V (With input supply voltage of 5.0 to 15VDC)
Supply current: ≈ 8mA
Supply voltage range of 2.7V to 15V (Below 5.0V, the voltage to the EQ-733L is unregulated)
Galvanic isolation between primary conductor and sensor
Interface Connector - 4 Pin 0.100" centers (Mating connector included)
Bi-directional sensing
Regulated Voltage Output (+5V) Pin (available for external use- up to 20mA)



AN-136KIT Outline Drawing (all dimensions in mm



AN_136KIT Electrical Block Diagram

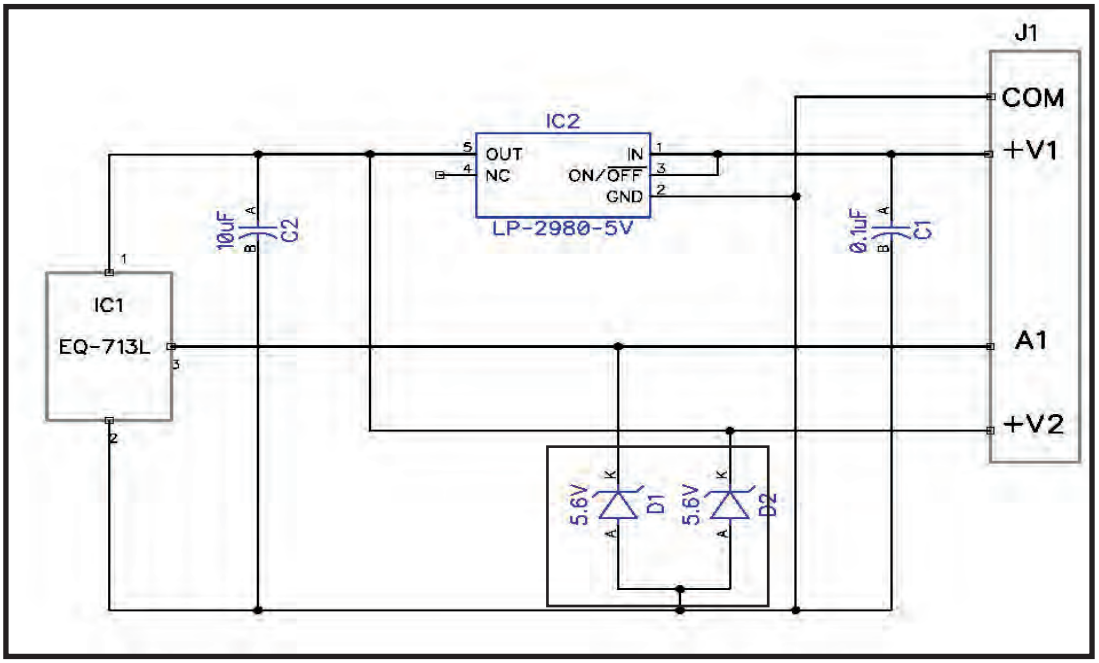
References:

Hall IC Specification EQ-733L

Ferrite Core Specification T 22G 22 14 07-05

Revision Date: 27 Oct 2009

Schematic, AN_136KIT

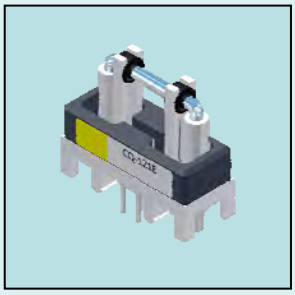


Parts List, AN_1356KIT

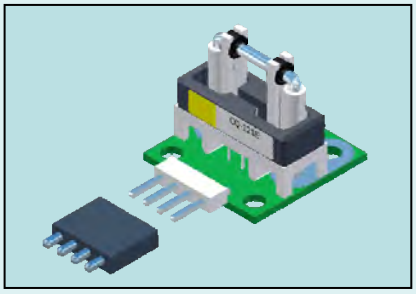
Item	Qty	Title	Reference(m	Vendor	Vendor P/N
1	1	IC, Linear Hall Effect, +/- 20mV/mT, EQ-713L	IC1	GMW Associates	EQ-713L
2	1	IC REG LDO MICROPOWER SOT23-5	IC2	Digi-Key Corporation	LP2980IM5-5.0CT-ND
3	1	CAP .1UF 50V CERAMIC X7R 0805	C1	Digi-Key Corporation	PCC1840TR-ND
4	1	Diode, Zener, 5.6V, SMD	D1/D2	Digi-Key Corporation	AZ23C5V6-FDITR-ND
5	1	CAP TANTALUM 10UF 6.3V 10% SMD	C2	Digi-Key Corporation	495-2180-1-ND
6	1	Conn Header 4POS 0.100 R/A Tin	J1	Digi-Key Corporation	WM6004-ND
7	1	Core, Ferite, 22mm x 14 mm x 7mm 1.25mm Gap	T1	Ceramic Magnnetics, Inc.	T 22G 22 14 07-02

Components

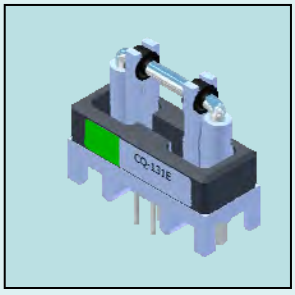
Engineering Kits



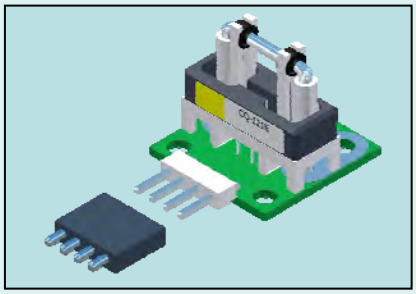
CQ-121E 25A



AN_165KIT 25A



CQ-121E 50A



AN_165KIT 50A

Features

- Very Low Noise
- High Isolation Voltage
- DC AC Operation
- Large Dynamic Range
- 3 to 5.5V Operation
- DC to 100kHz

ASAHI Current Sensor and Engineering Development Kits

GMW Associates www.gmw.com 650-802-8292

AN_165KIT-25A/50A - Asahi Current Sensor Engineering Evaluation Kits

General Description

The AN_165KIT-25A and AN_165KIT-50A engineering development kits provide an easy method of evaluating the Asahi CQ-121E and CQ-131E linear Hall current sensors. The AN_165KIT-25A demonstrates the Asahi CQ-121E sensor and has a current range of +/-25A. The AN_165KIT-50A demonstrates CQ-131E and has a range of +/-50A. The CQ Series incorporates the Asahi EQ-711L Linear Hall IC and a custom ferrite core.

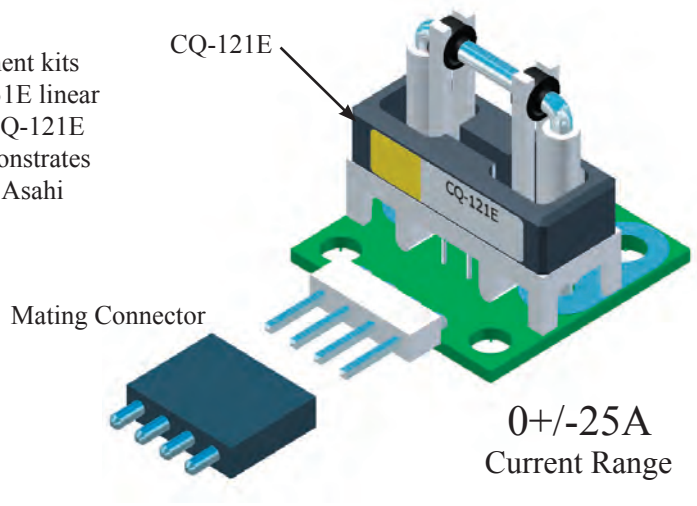
Included in the kit is a mating connector

References:

Asahi Sensor Specification CQ-121E/CQ-131E
Asahi Linear Hall Specification EQ-711L

KIT Part Numbers

AN_165KIT-25A
AN_165KIT-50A



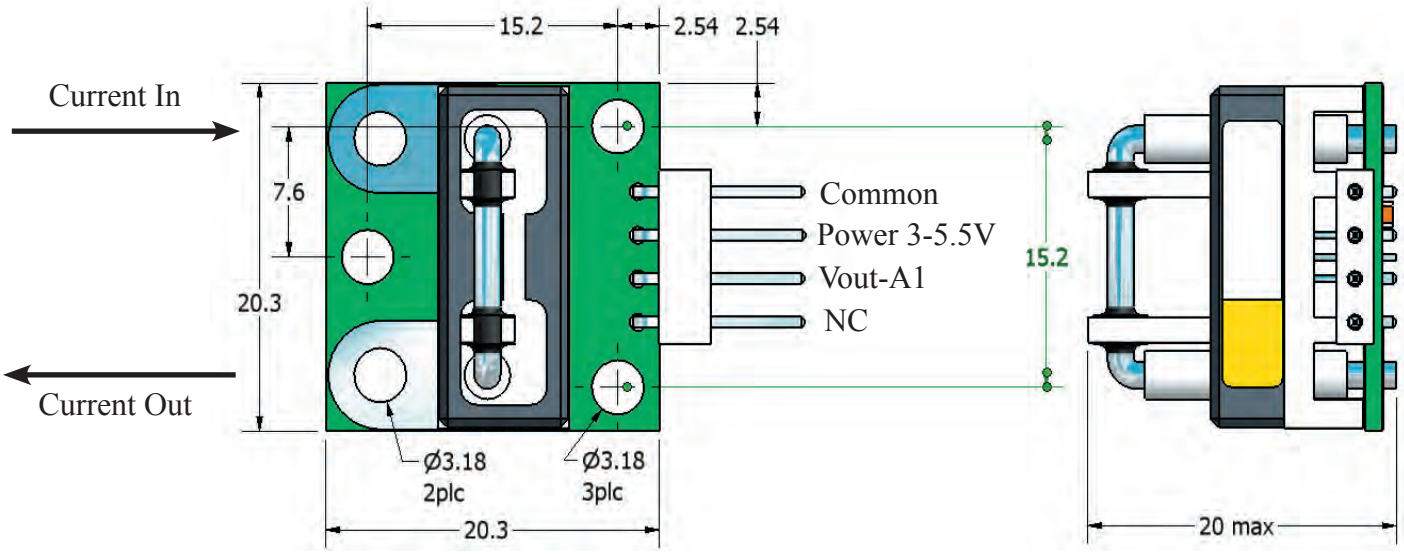
AN_165KIT-25A with mating connector

Features

Small-sized open loop current transducer using Linear Hall Effect IC
Galvanic isolation between the primary conductor and the Hall Effect IC.
Sensitivity range: 63+/- 8mV/A
Analog output voltage range: 1/2Vcc +/- 95% Vcc
Offset voltage: 1/2Vcc +/- 6%
Supply voltage range: 3-5.5V
Ratiometric analog output
Quick response: Typ. 3µs
Supply current: Typ.9mA
Operating Temperature Range:-30 to +80

CQ-121E

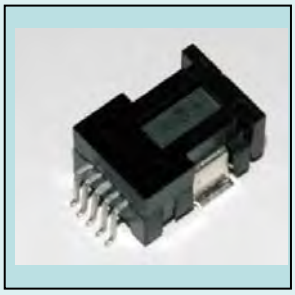
CQ-131E



AN-165KIT Outline Drawing (all dimensions in mm)

Revision Date: Feb 17 2011

Components



CQ-2092 +/-21A, 20Arms

CQ-2093 +/-35A, 20Arms

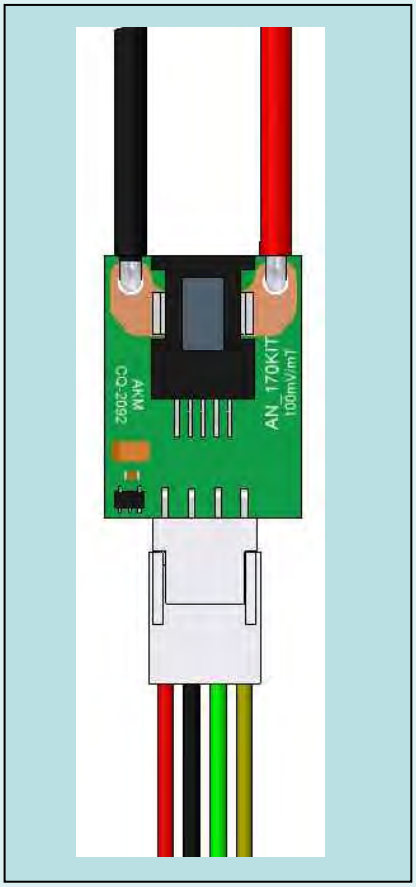
CQ-2063 +/-35A, 50Arms

CQ-2094 +/-54A, 50Arms

CQ-2063 +/-85A, 50Arms

CQ-2094 +/-130A, 50Arms

Engineering Kits



AN_170KIT

For the CQ-2092

Features

- 2,5V+/-2.4V signal
- Ratiometric output
- DC & AC operation
- Very low noise <2mVrms
- Large dynamic range: 1000:1
- High isolation voltage
- Single 5.0V supply
- DC to 400kHz
- 1uS response time
- +/-2 % accuracy

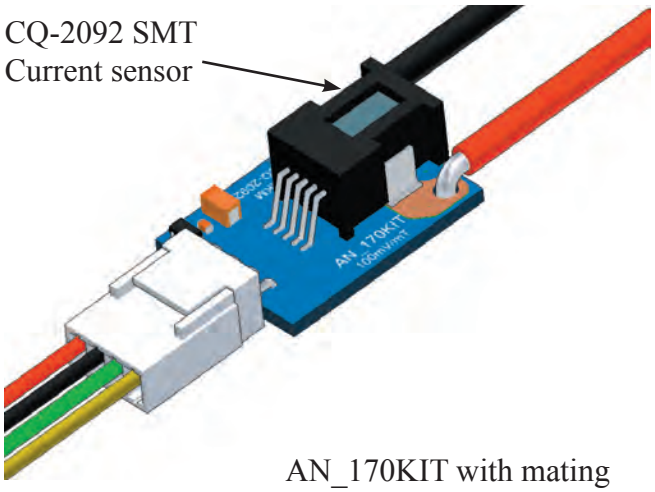
AKM Current Sensor and Engineering Development Kits

GMW Associates www.gmw.com 650-802-8292

AN_170KIT, AKM CQ-2092 Current Sensor Engineering Evaluation Kit

General Description

The AN_170KIT engineering development kit provides an easy method of evaluating the AKM CQ-2092 linear Hall current sensor. The AN_170KIT demonstrates the AKM CQ-2092 sensor and has a current range of +/-20A. The CQ-2092 current sensor incorporates the AKM EQ-950L factory programmed Linear Hall IC and a custom ferrite core. The kit includes a 5V regulator for the CQ-2092 and will operate with an input Vcc voltage of 5V to 24Vdc



AN_170KIT with mating connector and pigtail

References:

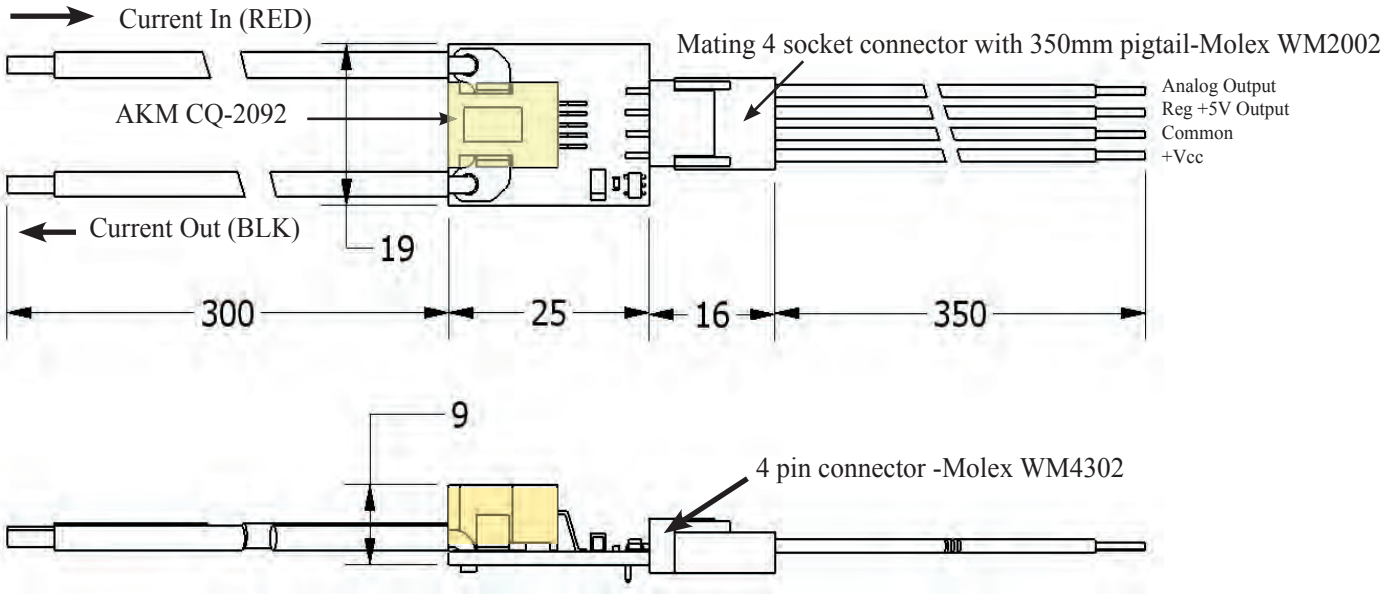
AKM Sensor Specification: CQ-2092 Linear Current Sensor

KIT Part Number

AN_170KIT

Features

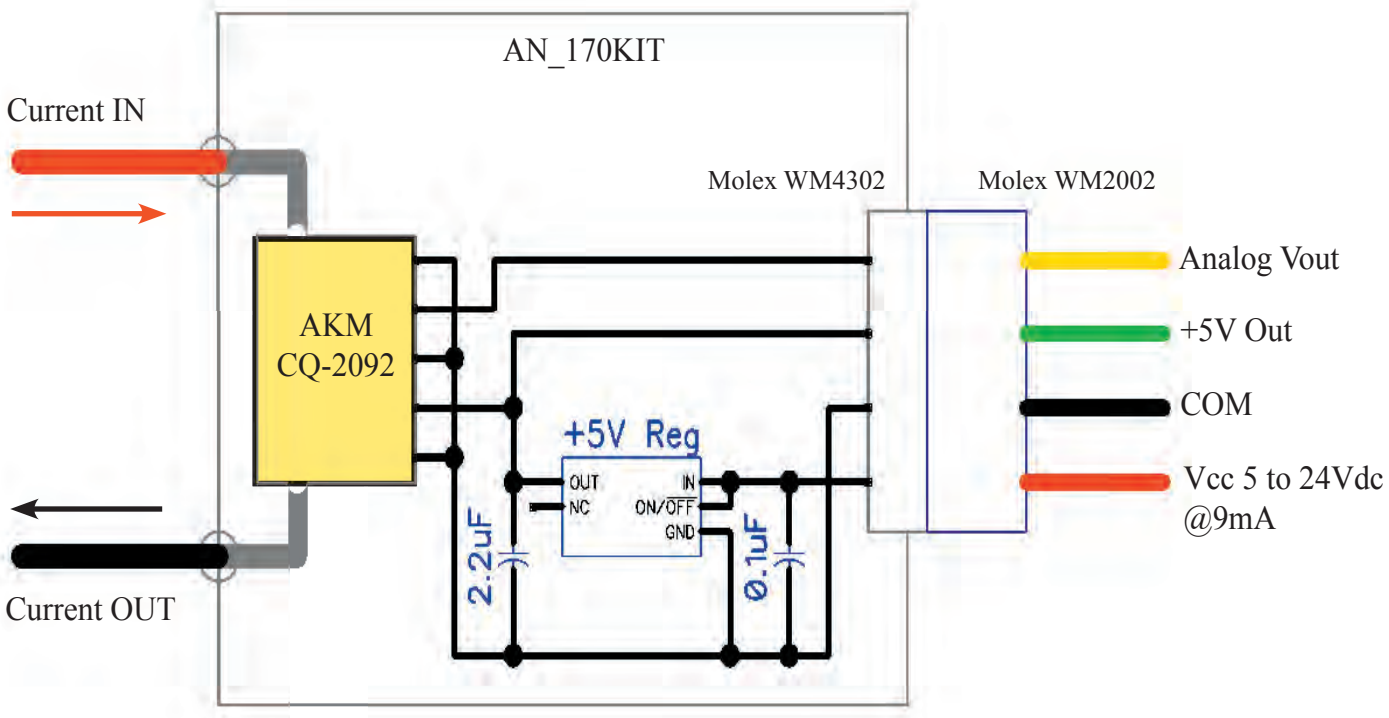
- Small-sized open loop current transducer using a factory programmed Linear Hall Effect IC
- Galvanic isolation between the primary conductor and the Hall Effect IC. >2.5kV
- Sensitivity range: 100+/- 2mV/A (+/-2%)
- Analog output voltage range: 2.5V +/- 2.4V
- Offset voltage: 2.50V +/- 110mV
- Kit supply voltage range: 5V to 24Vdc
- Supply current: Typ. <9mA
- Large BW: dc to 400kHz (-3db)
- Fast response: Typ. 1µs delay
- Ratiometric analog output
- Operating temperature range:-40 to +90 °C
- Very low output noise: <2.5mVrms
- Large Dynamic Range 1000:1



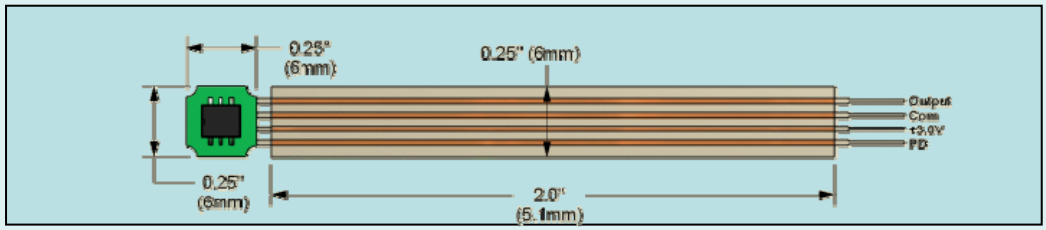
AN_170KIT Outline Drawing (all dimensions in mm)

Revision Date: May 9th, 2011

Schematic, AN_170KIT

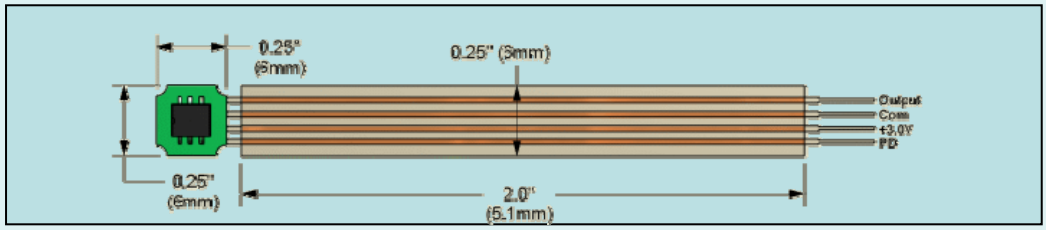


Reference Design RD101-EM-3242
With “Out of Range” Detector Disabled



AN_133KIT

Reference Design RD102-EM-3242
With “Out of Range” Detector Enabled



AN_134KIT

EM-3242 Features

- •Non–Contact Angle Sensing
- •3 to 5.5V Operation
- •360 Degree Range
- •Very small 6 Pin SMD
- •High Speed Operation
- •Large Air-Gap

ASAHI EM-3242 360 Degree Non-Contact Angle Sensing IC with Pre-Engineered Reference Designs and Development Kits

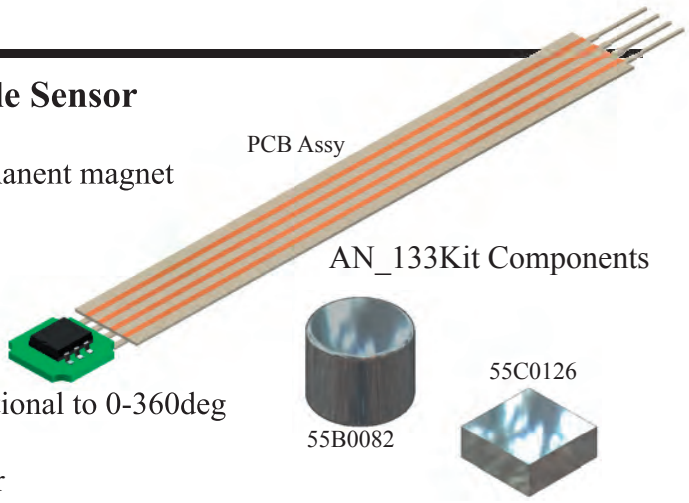
GMW Associates www.gmw.com 650-802-8292

ASAHI KASEI EMD - EM3242 Non-Contact Angle Sensor

Engineer Evaluation Kit

FEATURES of the EM3242Non-Contact Angle Sensor

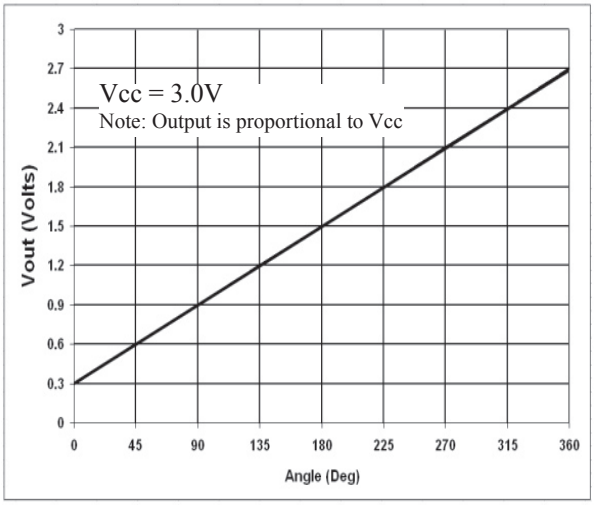
- Non-Contact Angle Sensing
- Senses magnetic field orientation of a small permanent magnet
- Small Size 3.6 x 3.0 x 0.8 mm - 6pin SOIC
- Resolution of up to 10 bits (0.35 deg)
- Non-linearity - 1%
- Low Power -Typ. 10mA @3.0V
- Sleep Mode - 1uA current draw
- Linear ratio-metric analog output voltage proportional to 0-360deg
- Single supply (2.7 to 5.25 V operating)
- Only one external part required - 0.1uF Capacitor
- Very High Speed > 8K RPM

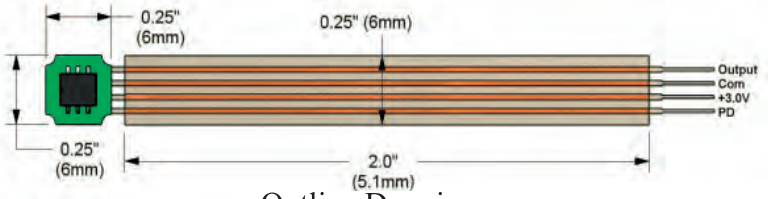


GENERAL DESCRIPTION

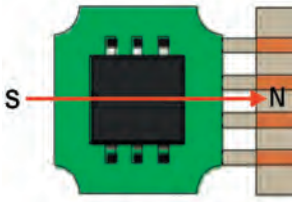
The AN_133KIT consists of a EM3242 angle sensor mounted on a small 0.25" square PCB with a 2 inch flat cable. Also included in kit are two SmCo24 magnets compatible with the angle sensor, a 0.25" dia. magnet and a 0.25" square magnet. The sensor works well with smaller magnets but with less air gap. This kit eliminates the need to design a PCB for testing which makes it convenient to evaluate the EM3242 for compatibility to the user's applications. See EM3242 specification for details.

EM3242 Angle Sensor, Output vs Angle



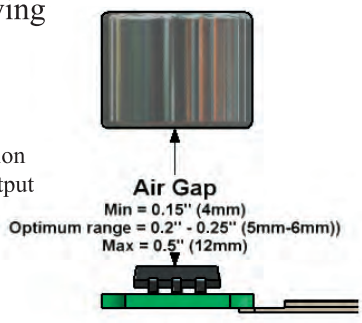


Outline Drawing

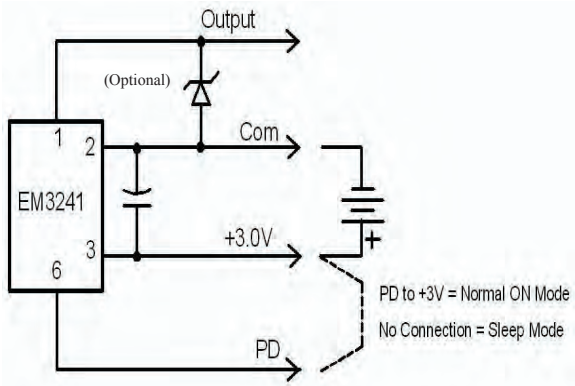


"0" Degrees
Clockwise rotation increases the output voltage.

Magnet Field Orientation



Air Gap range for standard RD and SQ magnets



Connection Diagram - AN_133KIT

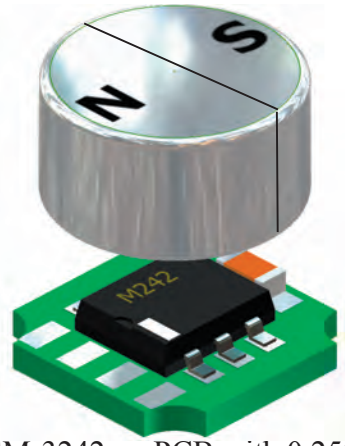
GMW 955 Industrial Road, San Carlos, CA 94070 Tel: (650) 802-8292 Fax: (650) 802-8298
E-mail: sales@gmw.com Web Site: www.gmw.com

AKM EM-3242 360 Deg Angle Position Ref Design without "In Range" Detection RD101-EM3242

The RD101-EM3242 is a reference design for the AKM EM-3242 Non-Contact Angle Position Sensing IC. The EM-3242 senses the angle of magnetic field component in the top plane of the device package. The EM-3242 provides an analog output voltage of 10% to 90% of the supply voltage for a mechanical angle range of 360 degrees of rotation. The EM-3242 has two operating modes. One with the "In Range" detector enabled and one with the "In Range" detector disabled. The "In Range" detector includes internal circuitry which causes the output voltage to drop to 0V whenever the magnetic field level at the EM-3242 is greater than 60mT or less than 10mT.
This reference design illustrates the operating mode which has the "In-Range" detector disabled. Please note that the PDN (Power Down) function is also disabled in this mode.

GMW offers a development kit that can be used to demostrate this reference design. The kit P/N is AN_133KIT

RD102-EM3242 details the design for a angle sensor that has the "In Range" detector enabled and the PDN (Power Down) enabled.



EM-3242 on PCB with 0.250" dia.. X 0.150 thick SmCo24 magnet (55B0082).

FEATURES

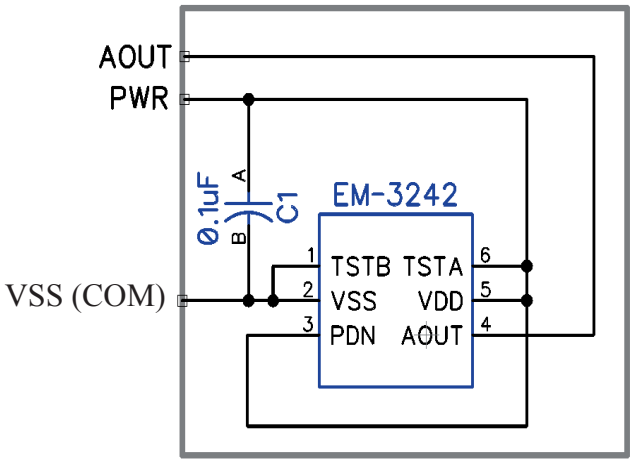
360 Degree Non-Contact Magnetic Angle Position Sensing
Analog Output 10% to 90% of VDD
Nonlinearity less than 3.5 deg at 3V
Magnetic to EM-3242 separation of 0.120' to 0.190" (55B0082 magnet)
Tolerant of mechanical misalignment
Expanded Magnet to IC separation with increased non-linearity
Only 1 external component required (0.1uF)
Less than 10mA operating current
Ratio-metric output
Very small 6 pin IC package (3.6mm x 4.2mm).
Circuitry fits on a 0.25" x 0.25" PCB.
10 Bit Resolution (0.36 deg)

Reference Documents

EM-3242 Specification Sheet - July, 2008
55B0082 Spec Sheet (0.25"dia. x 0.15"T SmCo24 Magnet)
55B0081 Spec Sheet (0.15"dia. x 0.15"T SmCo24 Magnet)
55C0126 Spec Sheet (0.25"Sq. x 0.10"T SmCo24 Magnet)
AN_133KIT- Eng Development Kit
RD102-EM3242 Ref Design for Angle sensing with "In Range" Detector

Magnetic flux density (Magnetic Field) units of Gauss and Tesla

1G=100uT or 0.1mT
10G =1mT
100G =10mT

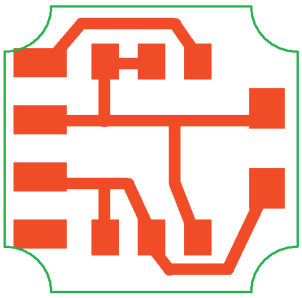


Schematic Diagram

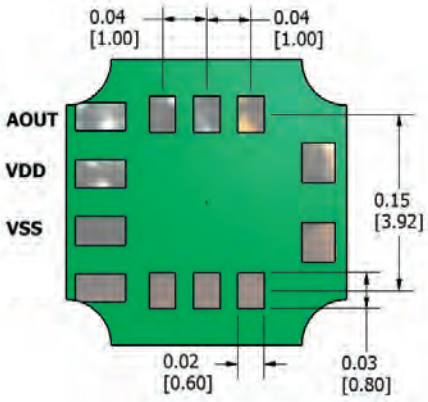
Bill of Material

IC-1 EM-3242 IC
C1- 0.1uF Ceramic cap-0603 SMD +/-10%
PCB FR-4, 0.8mm thick, 0.5 oz copper
55B0082 Cylindrical Magnet or
55B0081 Cylindrical Magnet or
55C0126 Square Magnet

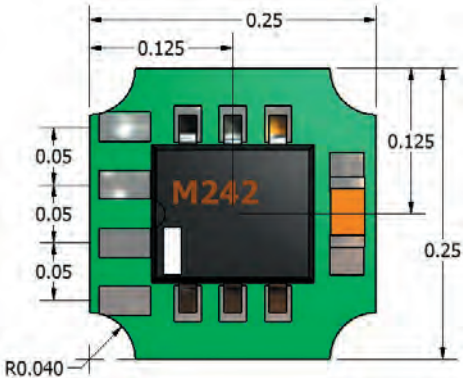
Revision Date: Feb 17. 2011



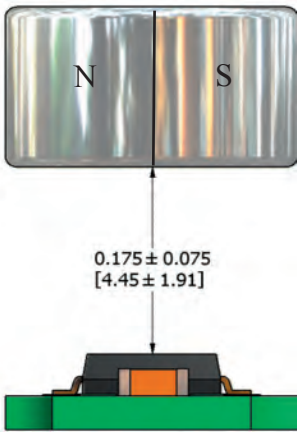
PCB Artwork



EM-3242 Solder PAD Recommendation

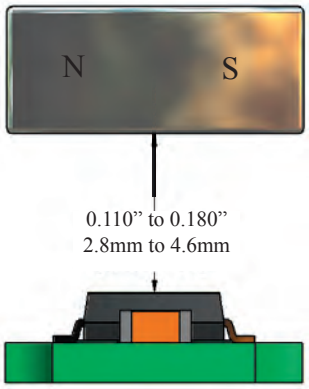


PCB Outline Diagram



Air Gap Operating Range for the 55B0082 Cylindrical Magnet

Air Gap Operating Range for the 55B0081 Cylindrical Magnet



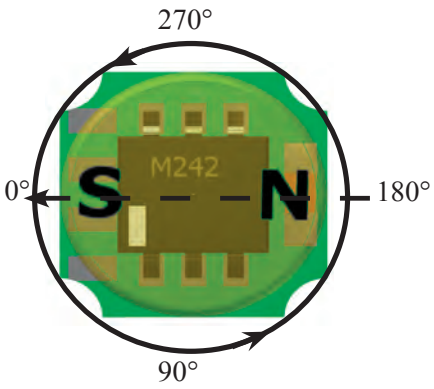
Air Gap Operating Range for the 55C0126 Square Magnet

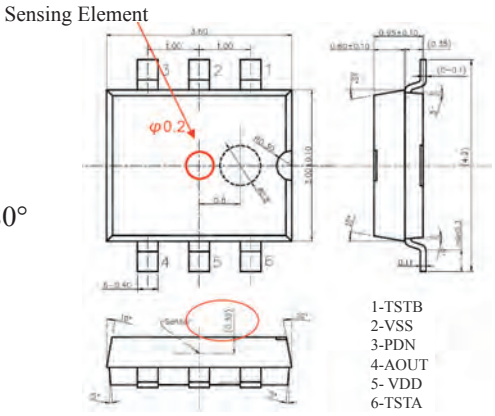
Air-Gap ranges to produce specified linear ouput. See graph on page 4 for expanded ranges

Magnet Orientation

Output increases as magnet is rotated CounterClockwise. See output curve, next page

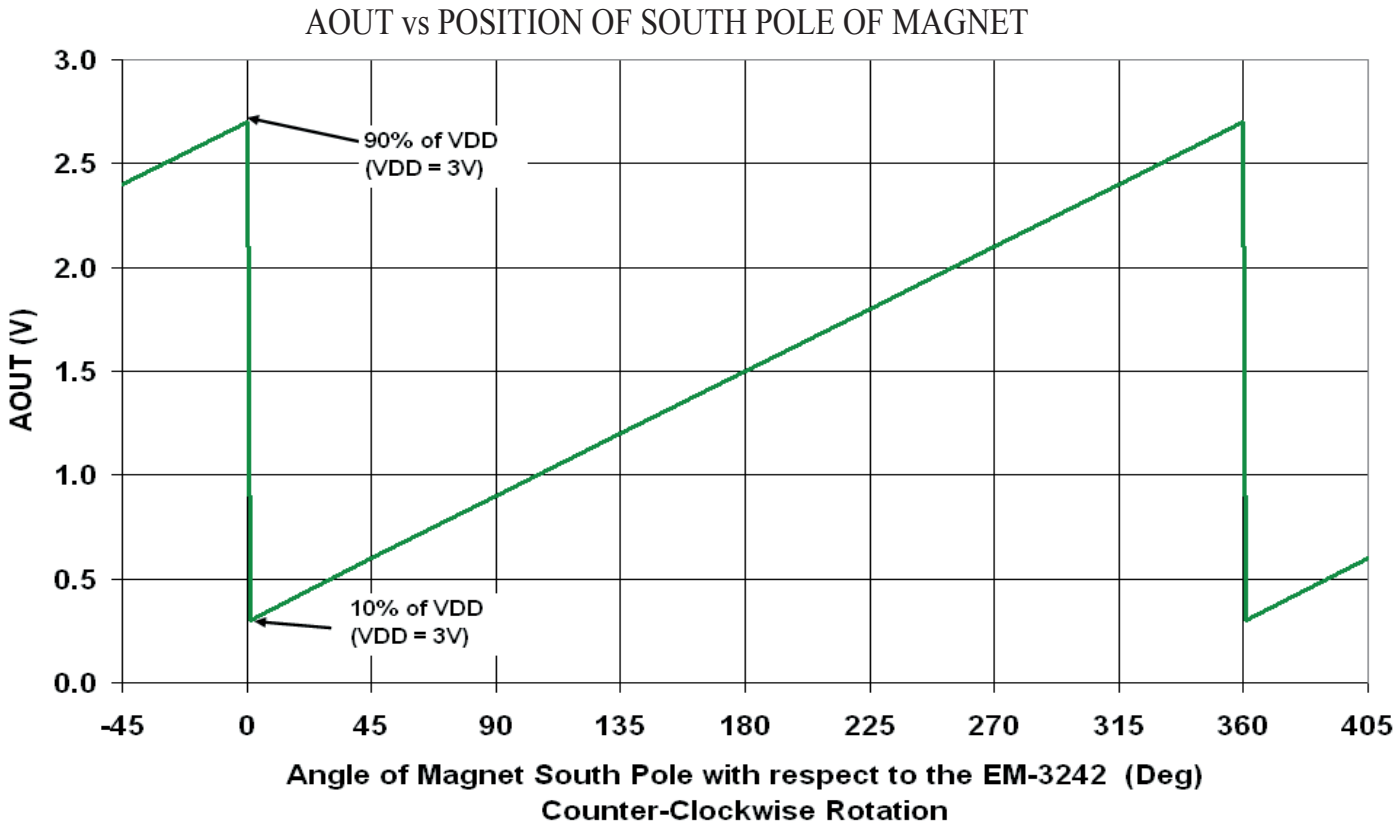
Zero Degrees occurs when the South Pole of the magnet is in line with pin and 6 of the IC.





EM-3242 Package and location of sesning element

Revision Date: Feb 17. 2011

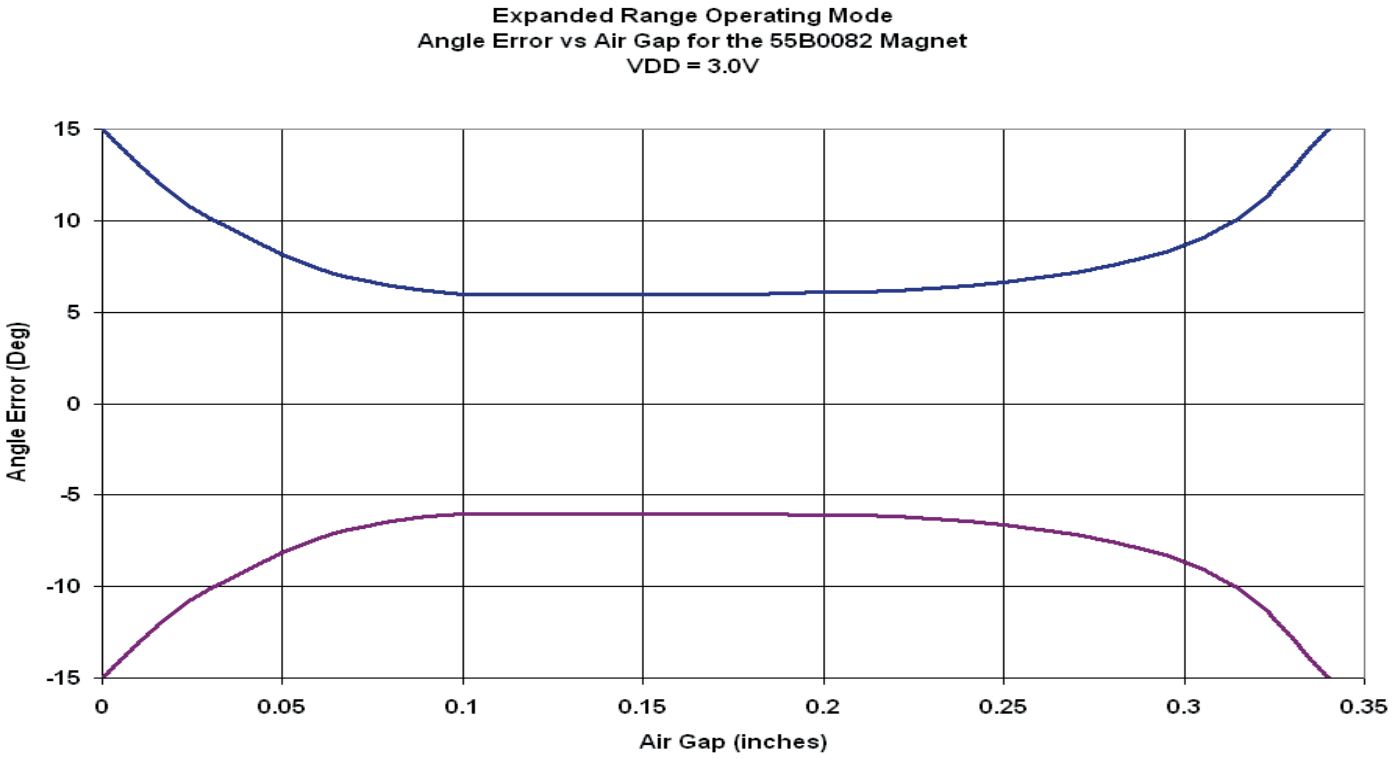


360 to 0 Degree Transition

When the Angle of rotation approaches the 360 degree position, the output will approach 90% of the supply voltage and then abruptly change to 10% of VDD and then start increasing again as the angle increases. This transition can be a wide as 0.5deg. If the position of the magnet is held steady at a point within the 0.5 deg. range, there is a possibility that the output will randomly switch between the 90% level and the 10% level. Both levels represent the same angle of 0 deg. If the output is filtered with a low pass filter, the average voltage output could be approximately 50% of VDD, thus creating an error in the reading. This can be avoided by not using a low pass filter. If a uP is used to sample the output, it can simply register a 10%VDD reading and a 90%VDD reading as the same angle (zero degrees).

Non-Linearity Specifications.

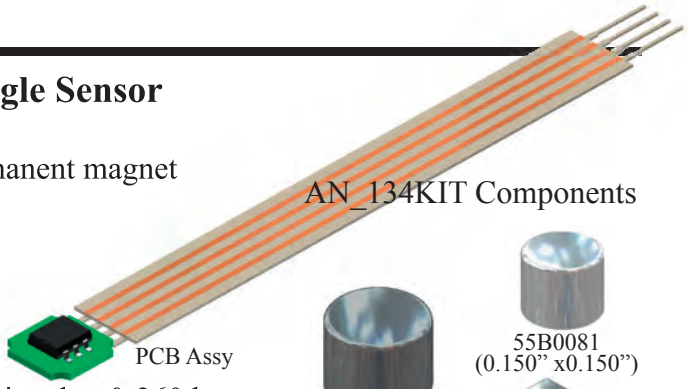
The EM-3242 is specified to operate within +/-6 degrees of non-linearity when the supply is 3V over the magnetic field range of 20mT to 40mT. With the "In Range" detector disabled, as in this case, the sensor will continue to function normally over a wider range, but with an increased angle error. The following graphs show the relationship between the non-linearity range and the air gap between the magnet and sensor for the 55B0082 magnet.


Expanded Range Operating Mode
Angle Error vs Air Gap for the 55B0082 Magnet
VDD = 3.0V
Angle Error (Deg)
15
10
5
0
-5
-10
-15
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Air Gap (inches)

ASAHI KASEI EMD - EM-3242 Non-Contact Angle Sensor without "In Range" Detection Engineering Development Kit

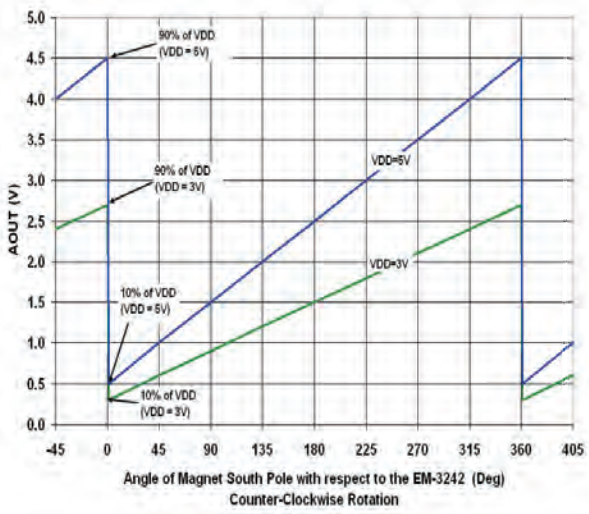
FEATURES of the EM-3242 Non-Contact Angle Sensor

- Non-Contact Angle Sensing
- Senses magnetic field orientation of a small permanent magnet
- Small Size 3.6 x 3.0 x 0.8 mm - 6 pin SOIC
- Resolution of up to 10 bits (0.35 deg)
- Non-linearity - 1% (at 3V)
- Low Power -Typ. 9mA
- Sleep Mode - 1uA current draw
- Linear ratio-metric analog output voltage proportional to 0-360deg
- Single supply (2.7 to 5.5V operating)
- Only one external part required - 0.1uF Capacitor
- Very High Speed > 8K RPM
- "Out of Range" Detection



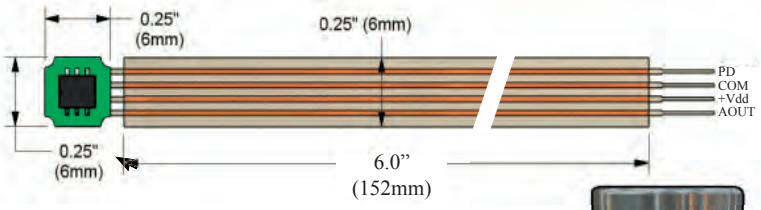
AN_134KIT Components

EM-3242 Angle Sensor, Output vs Rotation Angle

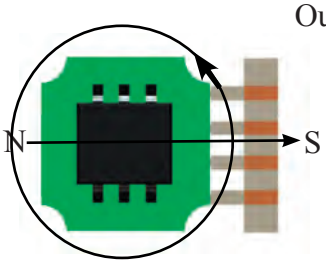


GENERAL DESCRIPTION

The AN_134KIT consists of a EM-3242 angle sensor mounted on a small 0.25" square PCB with a 6 inch flat cable. Also included in kit are three SmCo24 magnets compatible with the angle sensor, a 0.25" dia. magnet, a 0.15" dia magnet and a 0.25" square magnet. The sensor works well with smaller magnets but with less air gap. The Sensor incorporates a "Out or Range " detector circuit and will fault the output to zero volts when the magnet's strength is either too weak or too strong. See RD102-EM3242 for details. This kit eliminates the need to design a PCB for testing which makes it convenient to evaluate the EM-3242 for compatibility to the user's applications. See EM-3242 specification for details.

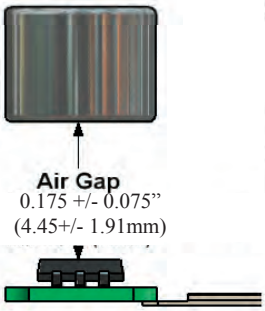


Outline Drawing

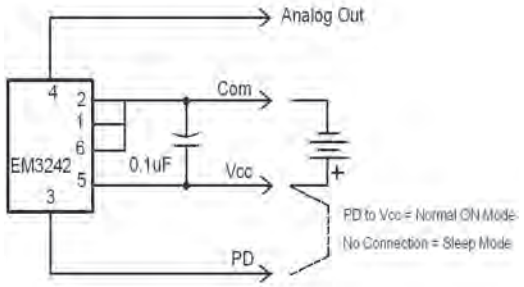


"0" Degrees
Counter Clockwise rotation increases the output voltage.

Magnet Field Orientation



Air Gap range for the 55B0082 standard magnets



Connection Diagram - AN_134KIT

Revision Date: 15 Dec 2009

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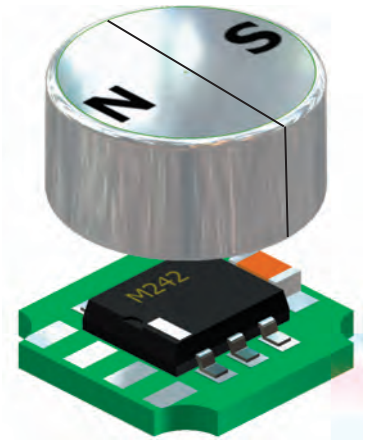
E-mail: sales@gmw.com Web Site: www.gmw.com

AKM EM-3242 360 Deg Angle Position Ref Design with "In Range" Detection and Power Down RD102-EM3242

The RD102-EM3242 is a reference design for the AKM EM-3242 Non-Contact Angle Position Sensing IC. The EM-3242 senses the angle of magnetic field component in the top plane of the device package. The EM-3242 provides an analog output voltage of 10% to 90% of the supply voltage for a mechanical angle range of 360 degrees of rotation. The EM-3242 has two operating modes. One with the "In Range" detector enabled and one with the "In Range" detector disabled. The "In Range" detector includes internal circuitry which causes the output voltage to drop to 0V whenever the magnetic field level at the EM-3242 is greater than 60mT or less than 10mT.
This reference design illustrates the operating mode which has the "In-Range" detector enabled. Please note that the PDN (Power Down) function is also enabled in this mode.

GMW offers an engineering development kit that can be used to evaluate this reference design. The P/N is AN_134KIT

RD101-EM3242 details the design for a angle sensor that has the "In Range" detector enabled and the PDN (Power Down) enabled.



EM-3242 on PCB with 0.250" dia. X 0.150 thick SmCo24 magnet (55B0081).

FEATURES

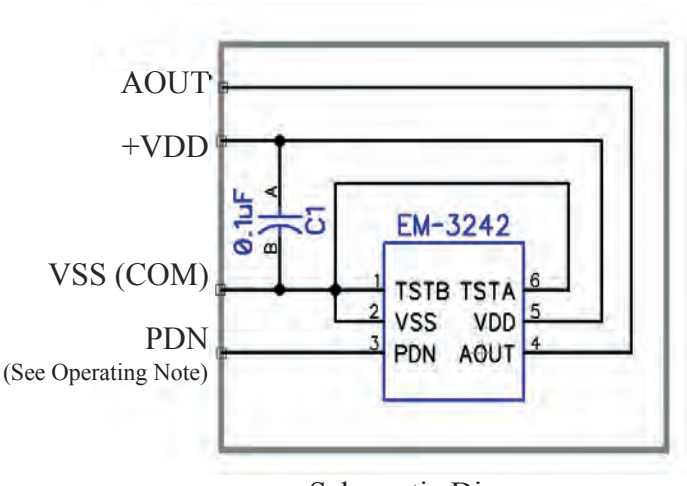
360 Degree Non-Contact Magnetic Angle Position Sensing
Analog Output 10% to 90% of VDD
Nonlinearity less than 3.5 deg at 3V
Magnetic to EM-3242 separation of 0.100' to 0.250"
Tolerant of mechanical misalignment
Expanded Magnet to IC separation with increased non-linearity
Out of Range Detection (Faults to 0V when Magnetic Field is >60mT or <10mT.
Power Down (PDN) option reduces current draw to <10uA.
Only 1 external component required (0.1uF)
Less than 10mA operating current
Ratio-metric output
Very small 6 pin IC package (3.6mm x 4.2mm).
Circuitry fits on a 0.25" x 0.25" PCB.
10 Bit Resolution (0.36 deg)
Fast update speed (40uS/update)

Reference Documents

EM-3242 Specification Sheet - July, 2008
55B0082 Spec Sheet (0.25"dia. x 0.15"T SmCo24 Magnet)
55B0081 Spec Sheet (0.15"dia. x 0.15"T SmCo24 Magnet)
55C0126 Spec Sheet (0.25"Sq. x 0.10"T SmCo24 Magnet)
AN_134KIT- Eng Development Kit
RD101-EM3242 Ref Design for Angle sensing without "In Range" Detector

Magnetic flux density (Magnetic Field) units of Gauss and Tesla

1G=100uT or 0.1mT
10G =1mT
100G =10mT



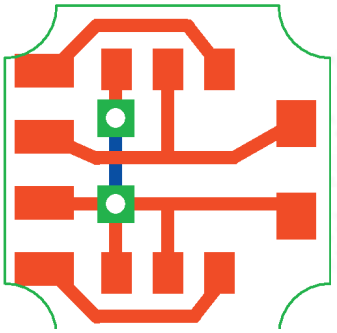
Schematic Diagram

Bill of Material

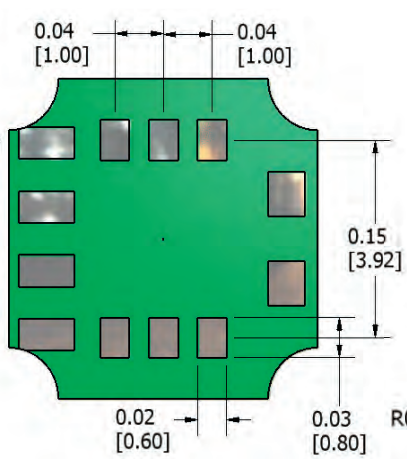
IC-1 EM-3242 IC
C1- 0.1uF Ceramic cap-0603 SMD +/-10%
PCB FR-4, 0.8mm thick, 0.5 oz copper
55B0082 Cylindrical Magnet or
55B0081 Cylindrical Magnet or
55C0126 Square Magnet

Operating Note:
Power Down (PDN) is enabled when PDN is tied to VSS (COM).
Tie PDN to +VDD activate the sensor for normal operation

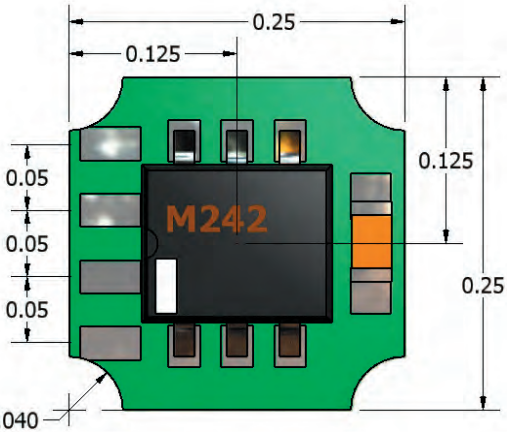
Revision Date: 7 Jan 2009



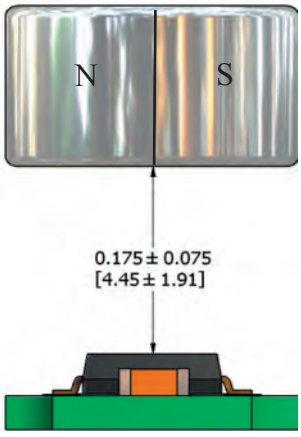
PCB Artwork



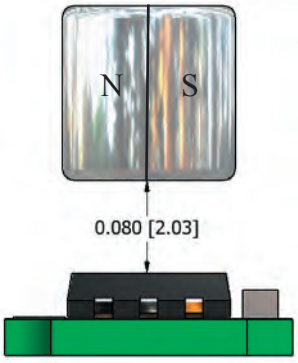
EM-3242 Solder PAD Recommendation



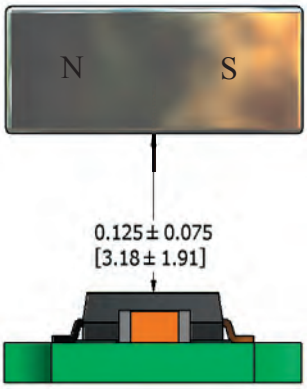
PCB Outline Diagram



Air Gap Operating Range for the 55B0082 Cylindrical Magnet



Air Gap Operating Range for the 55B0081 Cylindrical Magnet



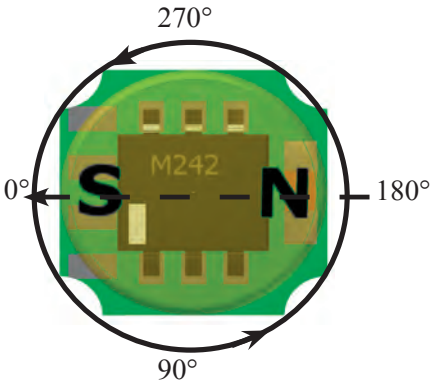
Air Gap Operating Range for the 55C0126 Square Magnet

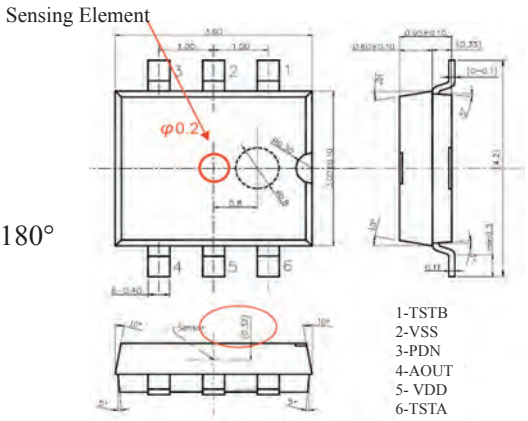
Air-Gap ranges to produce specified linear ouput. See graph on page 4 for expanded ranges

Magnet Orientation

Output increases as magnet is rotated CounterClockwise. See output curve, next page

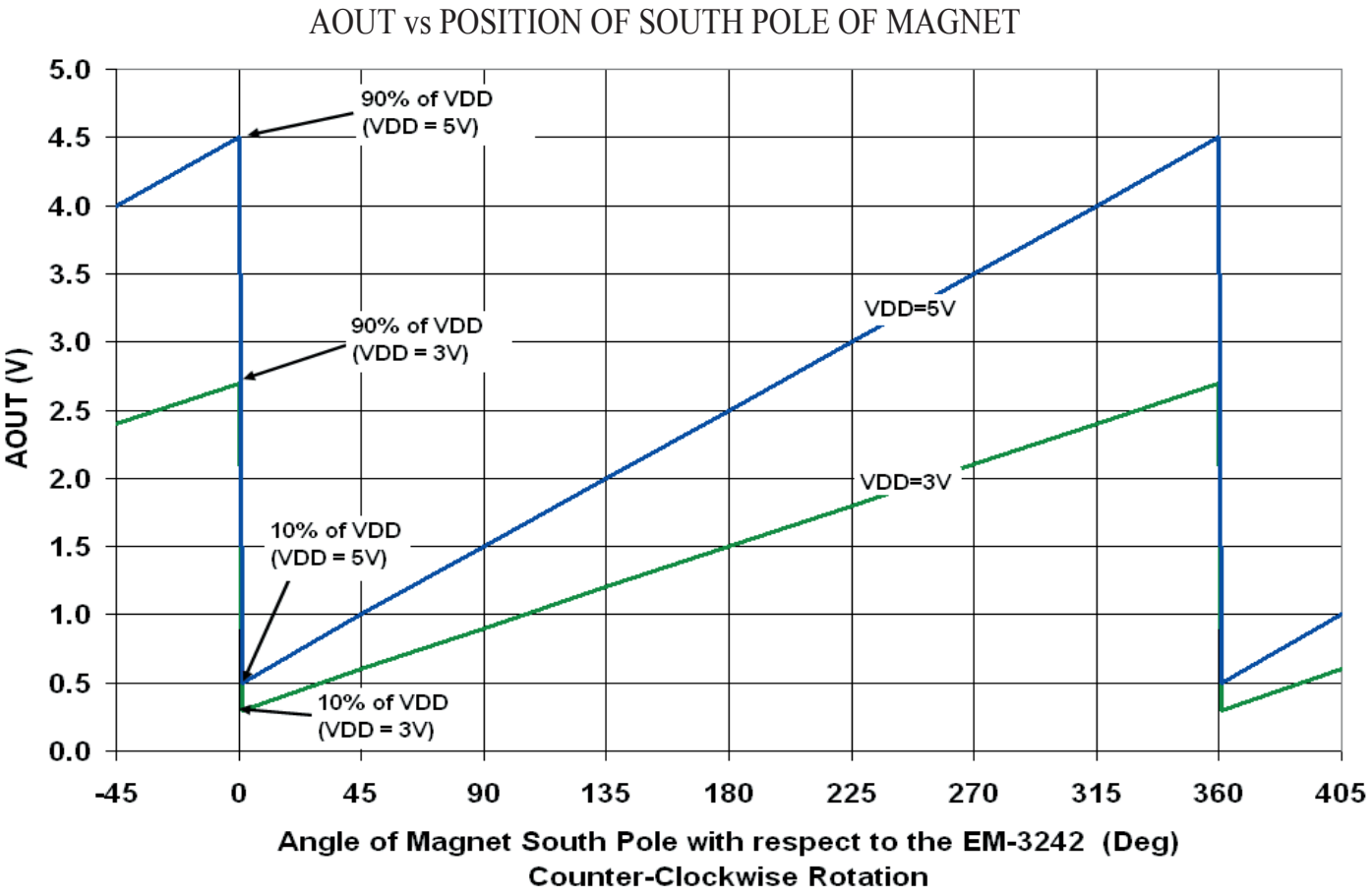
Zero Degrees occurs when the South Pole of the magnet is in line with pin and 6 of the IC.





EM-3242 Package and location of sesning element

Revision Date: 7 Jan 2009

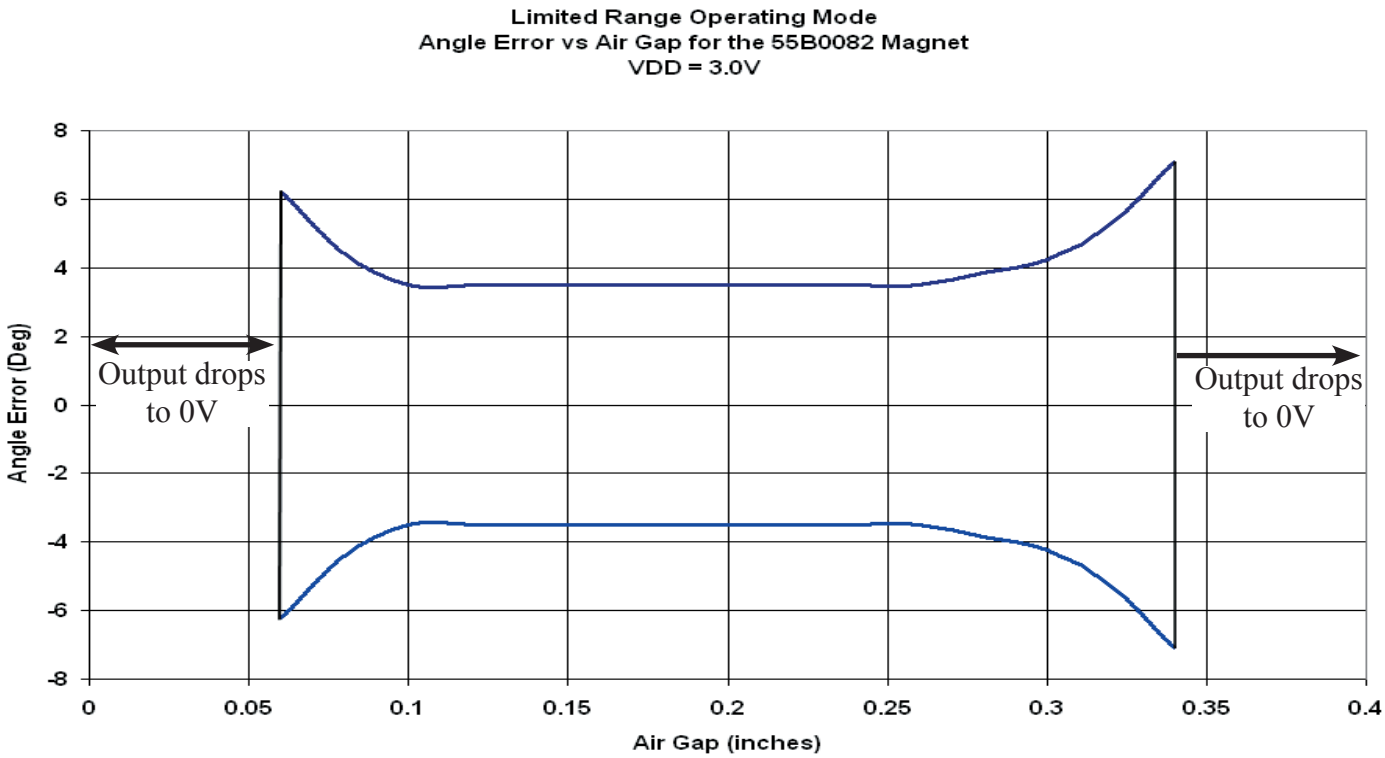


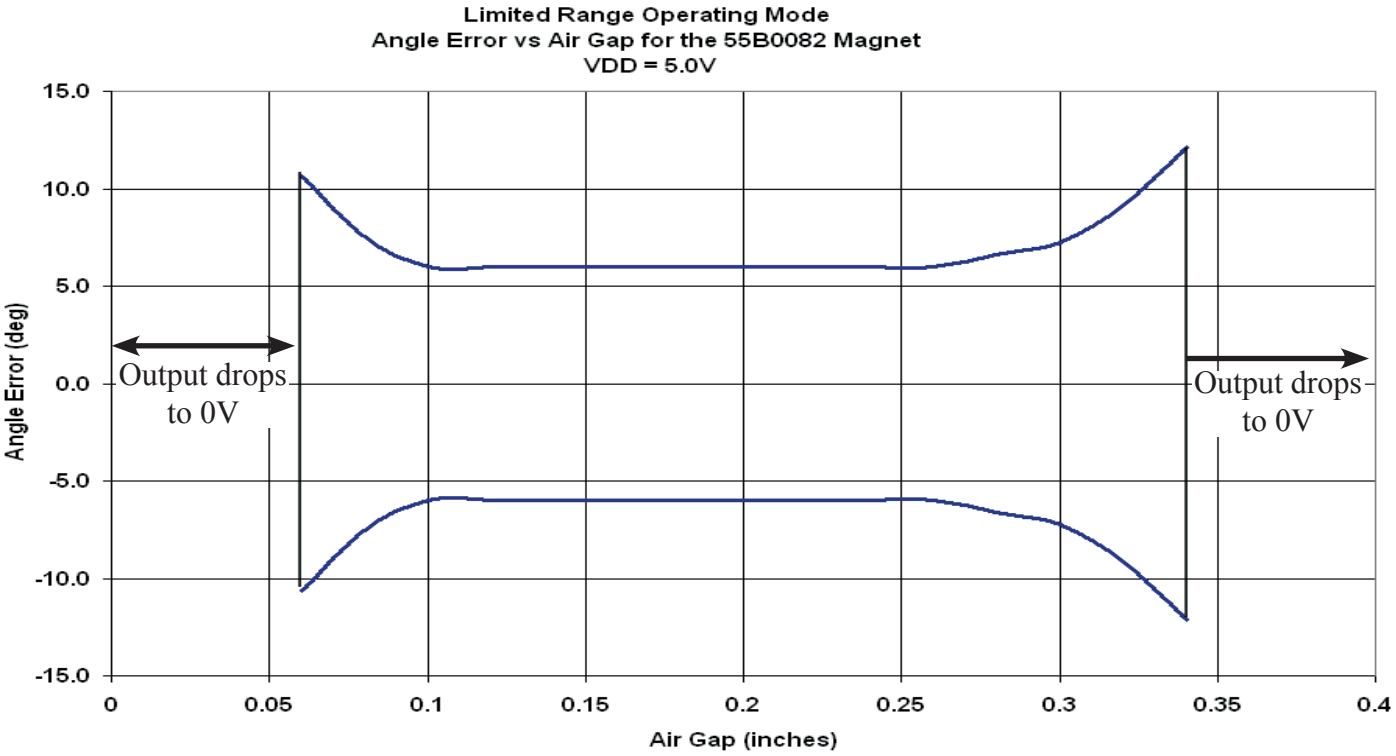
360 to 0 Degree Transition

When the Angle of rotation approaches the 360 degree position, the output will approach 90% of the supply voltage and then abruptly change to 10% of VDD and then start increasing again as the angle increases. This transition can be a wide as 0.5deg. If the position of the magnet is held steady at a point within the 0.5 deg. range, there is a possibility that the output will randomly switch between the 90% level and the 10% level. Both levels represent the same angle of 0 deg. If the output is filtered with a low pass filter, the average voltage output could be approximately 50% of VDD, thus creating an error in the reading. This can be avoided by not using a low pass filter. If a uP is used to sample the output, it can simply register a 10%VDD reading and a 90%VDD reading as the same angle (zero degrees).

Non-Linearity Specifications.

The EM-3242 is specified to operate within +/-3.5 degrees of non-linearity when the supply is 3V and +/-6 degrees when the supply voltage is 5V over the magnetic field range of 20mT to 50mT. With the "In Range" detector enabled, as in this case, the sensor will continue operate normally until the magnetic field strength at the sensor either exceeds 60mT or drops below 10mT. When these limits are exceeded, the output of the EM-3242 will drop to 0.2V or less. The following graphs show the relationship between the non-linearity range and the air gap between the magnet and sensor for the 55B0082 magnet.


Limited Range Operating Mode
Angle Error vs Air Gap for the 55B0082 Magnet
VDD = 3.0V
Angle Error (Deg)
8
6
4
2
0
-2
-4
-6
-8
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Air Gap (inches)
Output drops to 0V
Output drops to 0V


Limited Range Operating Mode
Angle Error vs Air Gap for the 55B0082 Magnet
VDD = 5.0V
Angle Error (deg)
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Air Gap (inches)
Output drops to 0V
Output drops to 0V

Case Studies

AKMCS-001 Non Contact Remote ON-OFF

AKMCS-002 Flow Meter using EM3242 Angle Sensor

AKMCS-003- Flow Meter using AKM Encoder IC's

AKMCS-004 Accurate Switching using AKM Hall devices

AKM Case Study: AKMCS 001
Non-Contact power turn ON/OFF

Problem to be solved:

Customer needs a solution for turning power ON and OFF in a sealed container (In this case, a small battery operated gastrointestinal ingestible capsule). The capsule contains sensors and telemetry circuitry that is powered by a small battery.

The customer's needs are the following:

1) Very low operating current draw
2) Operate at low battery voltages
3) Activated with a magnet
4) Needs to be latched ON or OFF with the external magnet
5) Small size

GMW recommended solution

GMW offered the customer a solution that would use the AKM Low Power Hall switch to activate the internal circuitry with a magnet. The Hall IC recommended was the AKM EM-1712 which has the following characteristics applicable to the issue.

1) Very low operating current <60uA. This will be well suited for battery operation
2) The operating voltage is 1.6V to 5.5V
3) The IC is a Hall switch which is activated by a magnetic field, in this case from a small magnet
4) The IC is a "Latching Hall" device whose output remains in the state that it was last activated to. A North pole of a magnet will switch the output to high and a South pole will latch the output to low. This allows the customer to turn the IC on (That is: Latch it ON) and then turn it off with an external magnet. Once the capsule is assembled and just prior to shipment, it is sealed and tested by momentarily switching the device ON and OFF.
5) The EM-1712 IC comes in a very small SMT package (2.1mm square). AKM has a smaller version, the EM-0712, which comes in a leadless SON package however in this case, the customer preferred the leaded SMT package.

Revision Date: 21 Jan 2011

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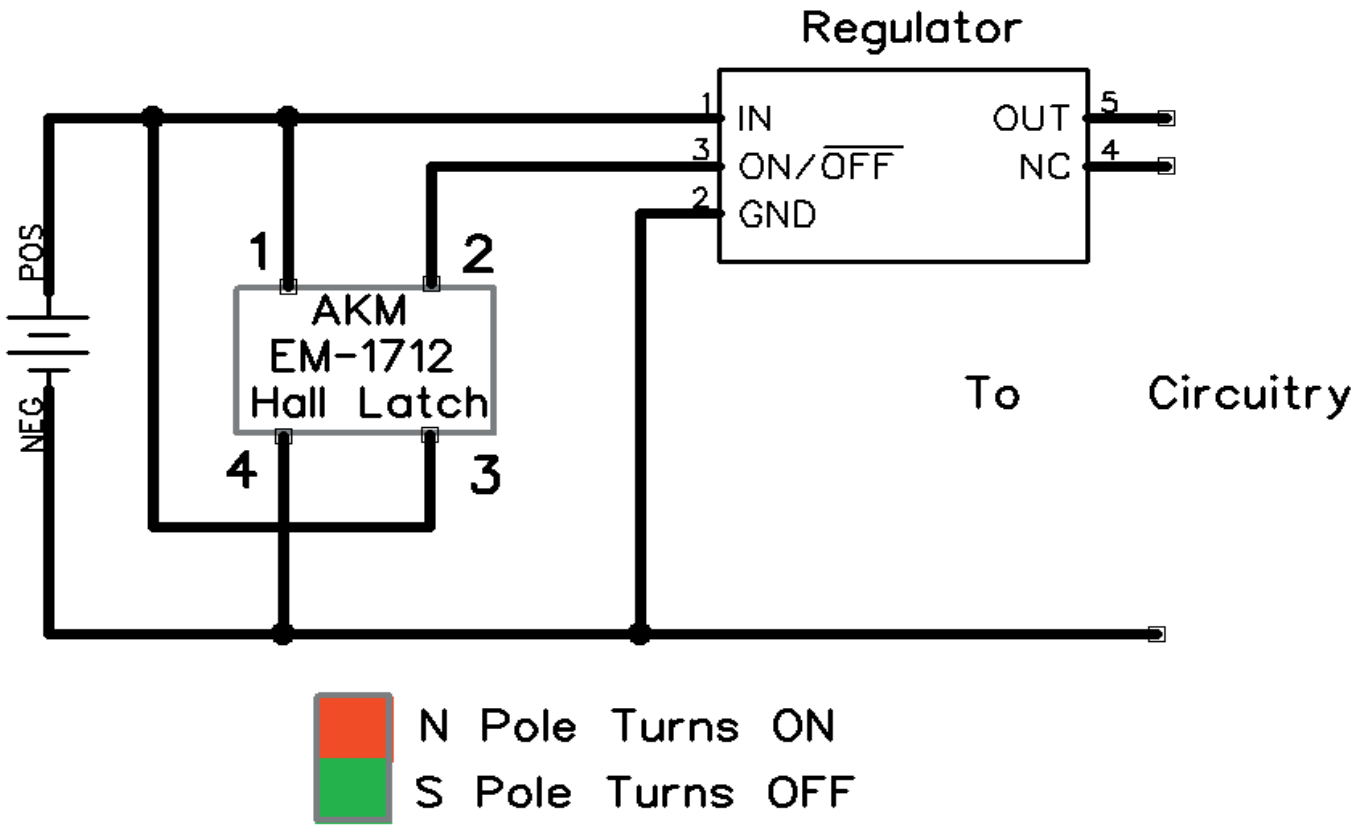
AKM Case Study: AKMCS 001
Non-Contact power turn ON/OFF

Below is a typical schematic of the AKM EM-1712 being used to turn power ON and OFF. Thsi circuit shows the AKM EM-1732 being used to turn a regulator circuit On and OFF . When the EM-1712 is in the OFF state (South Pole toward the top of the IC), the EM-1712's output is LOW, which disables the regulator. When the EM-1712 is activated and latch to the high state with a North pole facing the top of the IC, the regulator is turned on to activate the circuity in the capsule. Because the EM-1712 is a "Latching" Hall IC, it will remain in a given state until activated by a magnet with the opposite polarity.



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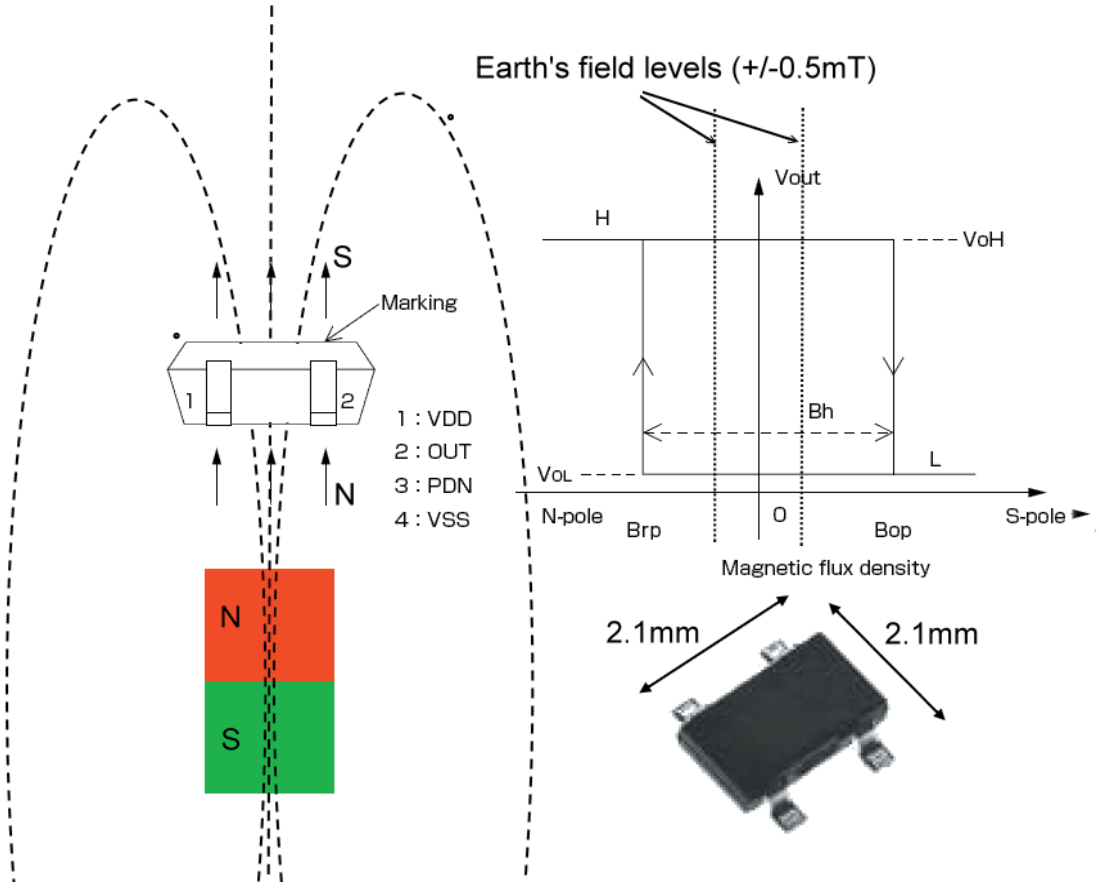
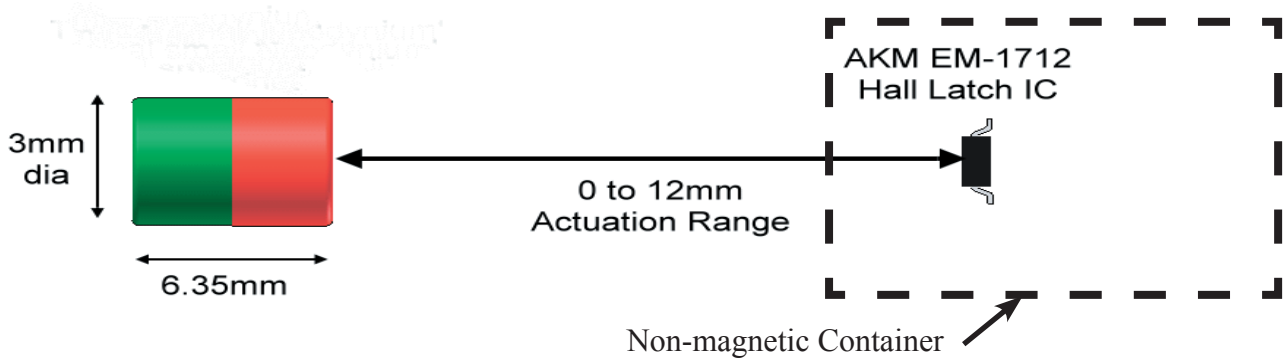
Email: sales@gmw.com Web site: http:// www.gmw.com

Below are the technical details of the switch operation. The magnet North pole of a magnet facing the bottom of the IC will cause the output to switch "Low". A North pole of a magnet facing the top of the IC will switch the output to the "High" state. The switch levels are well above the Earth's magnetic fields which are typically in the range of +/- 0.5mT



Very small magnets can be used to activate the switch. Below is a typical activation range of the AKM EM-1712 using a 6.35mm long by 3mm diameter



Revision Date: 21 Jan 2011

AKM Case Study: AKMCS-002
Flow meter using an EM-3242 angle sensor IC

Problem to be solved:

Customer needs a solution for measuring liquid flow that will be reported in Gallons. The concept is an impeller type flow meter with a magnet mounted on the end of the rotating shaft. The rotating impeller and magnet are in a sealed non magnetic housing. The rate of turning is relatively slow, so the customer need at least 8 bits of resolution for each turn.
A summary of the customer's needs are the following:

1) Low cost sensor
2) Low operating voltage
3) Sensor that is responsive to a rotating horizontal magnetic field
4) Operate at a large gap with small magnet
5) A minimum of 8 bits of resolution per 360 degrees

GMW recommended solution

GMW offered the customer a solution that would use the AKM self contain angle sensing IC. The AKM IC recommended was the AKM EM-3242 which has the following characteristics applicable to the issue.

1) Very low cost. In the $1.00 range at 80K-100K/Yr
2) The operating voltage is 2.7V to 5.5Vdc
3) The IC measures the angle of a rotating magnetic field that is parallel (horizontal) to the IC surface.
4) The IC has a sensitivity level of 20mT min. Using a 5mm diameter Neodymium magnet, this correlates to a 3mm operating range between the magnet and the face of the IC.
5) The EM-3242 has a resolution of 10 bits (~0.35 deg) which is 4x better resolution than requested.

In a flow meter, the more resolution it has, the more precise the flow measurement can be. For example: if a given meter has an impeller that rotates one turn for every gallon of liquid and the resolution of the sensing measurement is one pulse per turn, then the measurement resolution is only 1 gallon. If there are 10 pulses per turn, then the resolution of the flow meter is 0.1 Gallons. If the measurement system has a resolution of 8 bits (or 254 counts per revolution), the precision of the measurement is 0.004 gallons. In this case, the EM-3242 is more than adequate for the meter requirements

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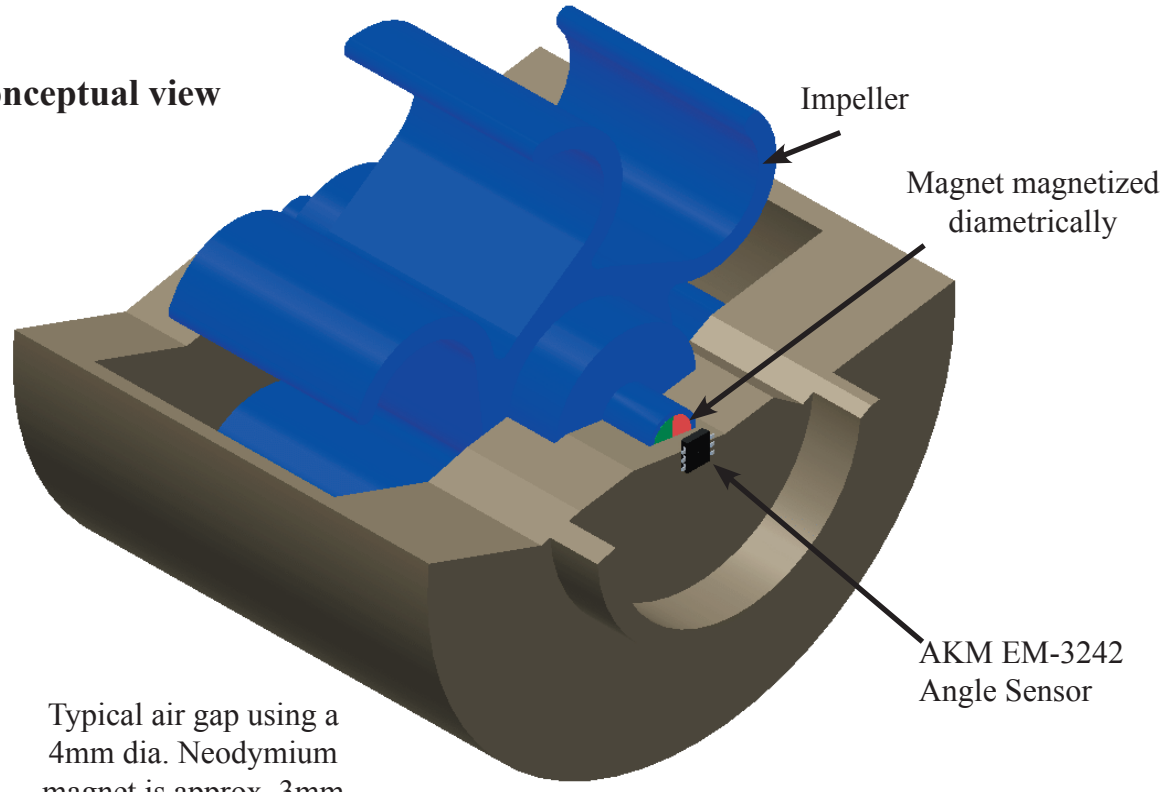
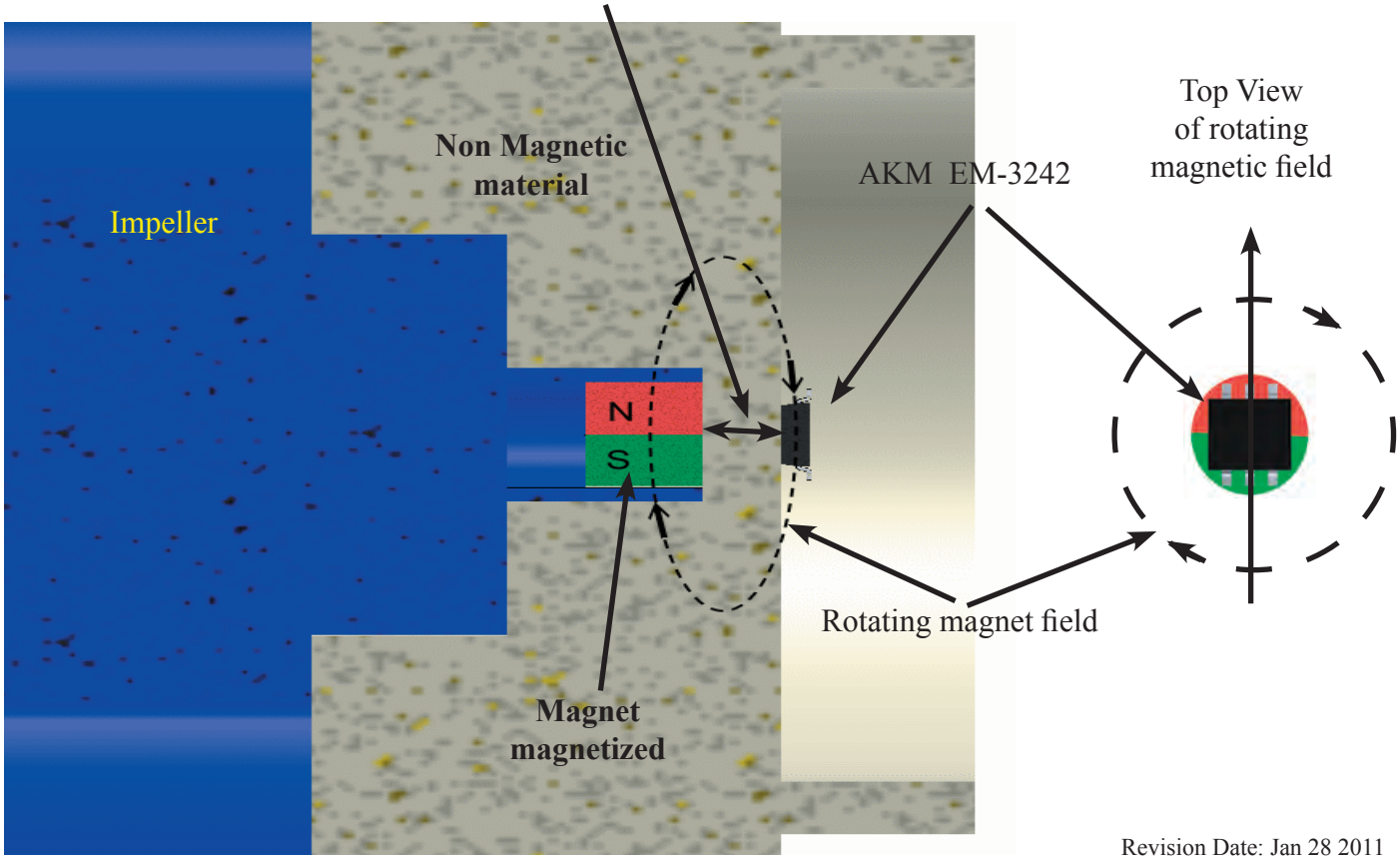
AKM Case Study: AKMCS-002
Flow meter using an EM-3242 angle sensor IC

Flow meter conceptual view



Typical air gap using a 4mm dia. Neodymium magnet is approx. 3mm



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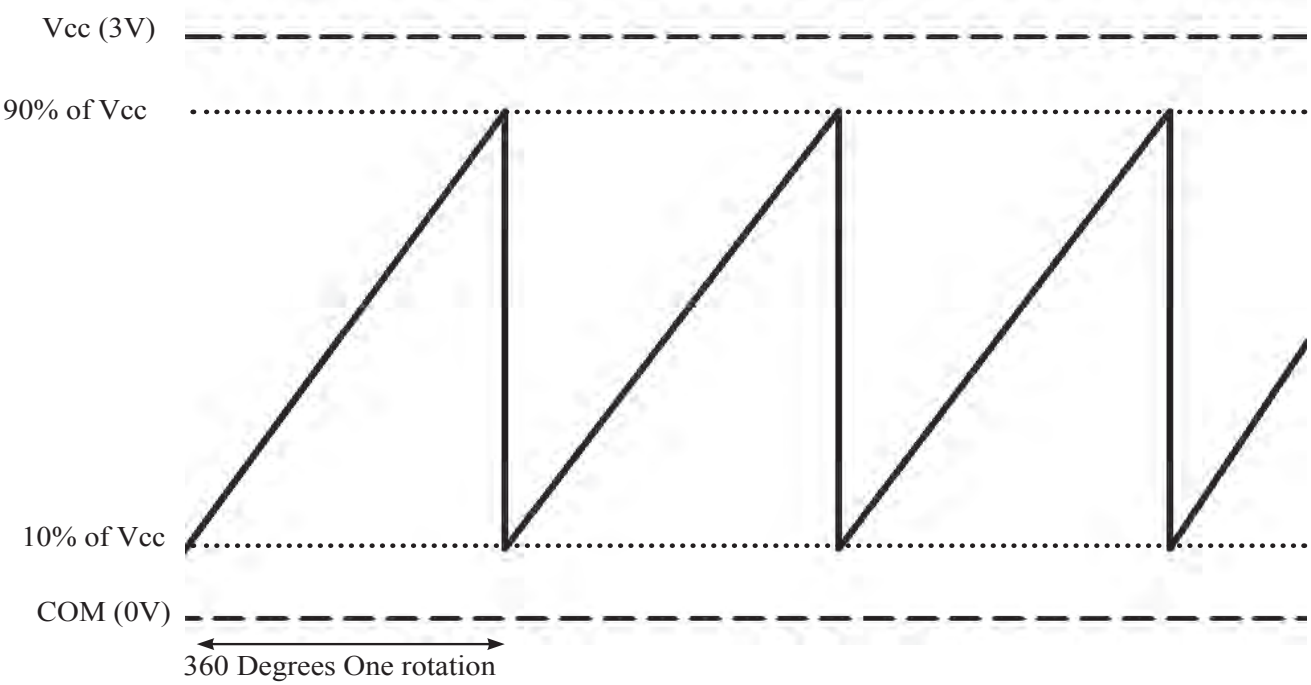
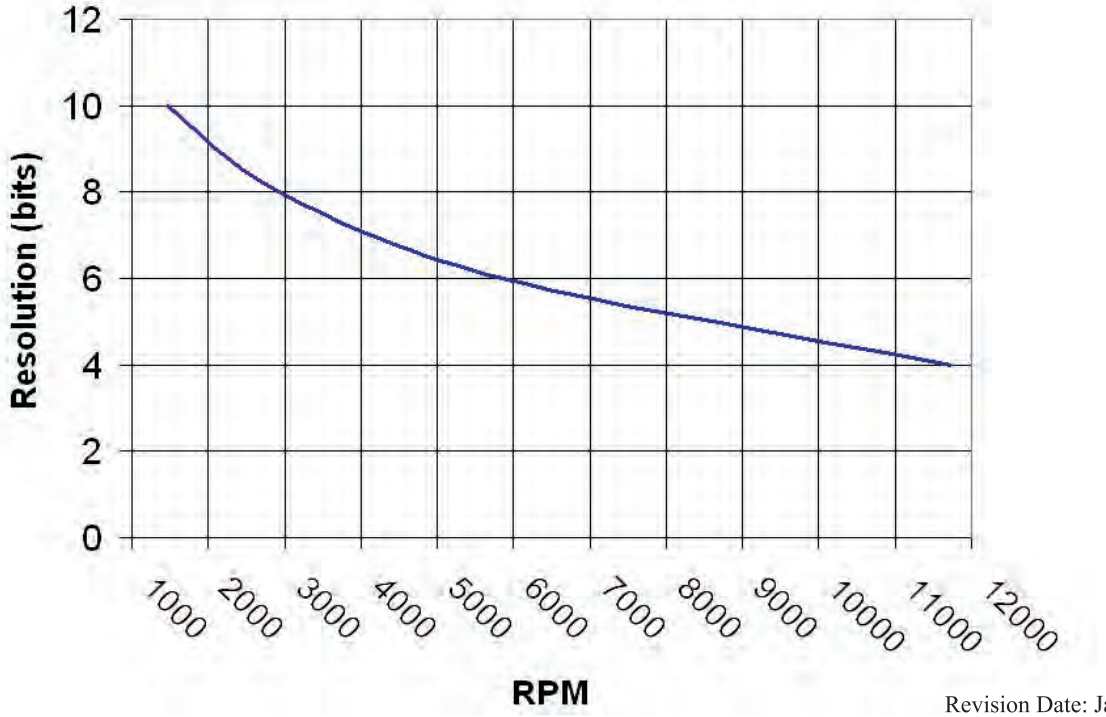
EM-3242 Output signal. Repeating Saw Tooth waveform that starts at 10% of the supply voltage and increases linearly to 90% of Vcc. The resolution of the linear ramp is 10 bits (1024 steps). Each step updates every 40uS, therefore to maintain 10 bits of resolution, the maximum rotational speed would be approximately 1500 rpm. The EM-3242 is capable of higher speeds, but the resolution will be less, see graph below.



EM-3242 Resolution as a function of rotational speed



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AKM Case Study: AKMCS-004
Non-Contact Accurate Switching with Hall IC's

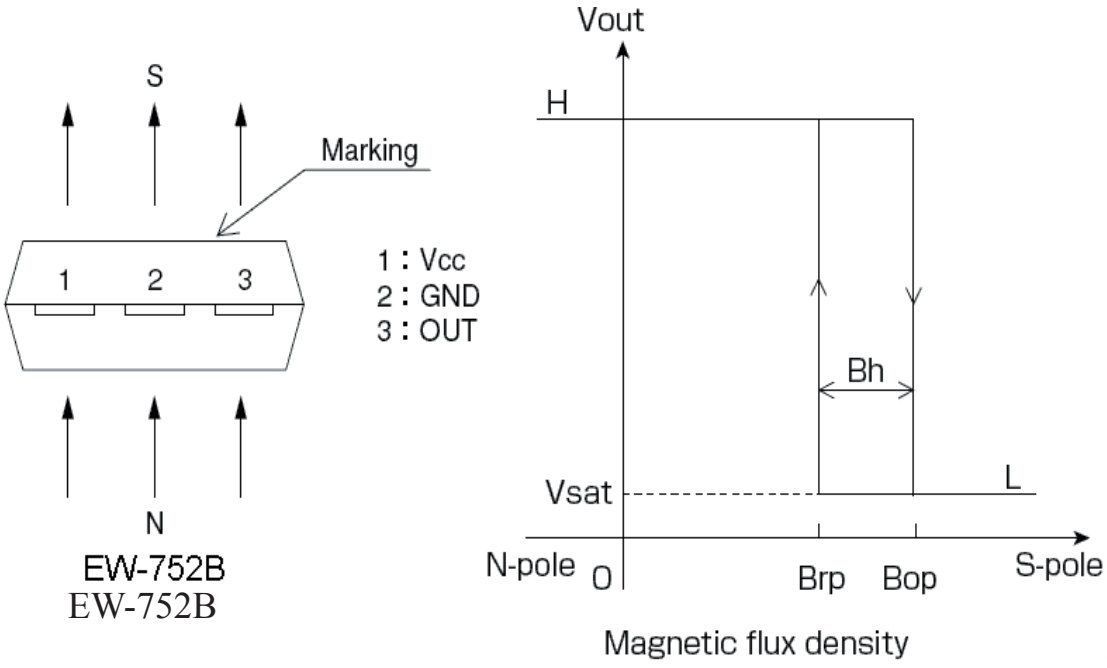
Problem to be solved:

Customer needs a non-contact magnet activated switch that will provide a very accurate and repeatable switch point for an end of travel application

1) Very accurate switch point
2) Hall based switch in SIP package
3) Activated with a magnet
5) Small size

GMW recommended solution

GMW presented a solution to use an AKM EW-752B Unipolar Switching IC. The EW-752B has a bipolar transistor output with an internal 5K pull up resistor. The EW-752B has a wide range operating voltage of 3 to 26V and a switch operate point Bop between 4mT and 10mT, typically = 6mT. The switch turns ON when the South pole field facing the sensor with the marking, exceeds the Bop point. See blow the basic operating characteristics.



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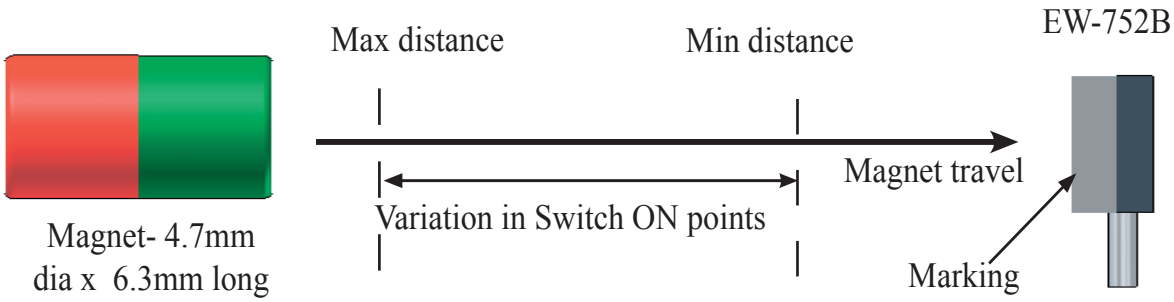
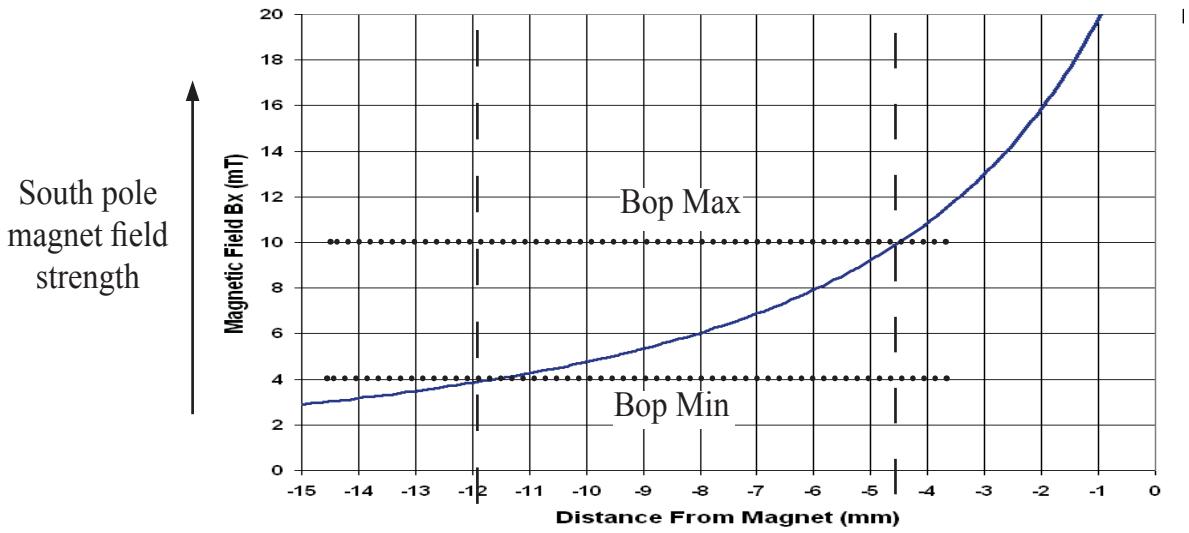
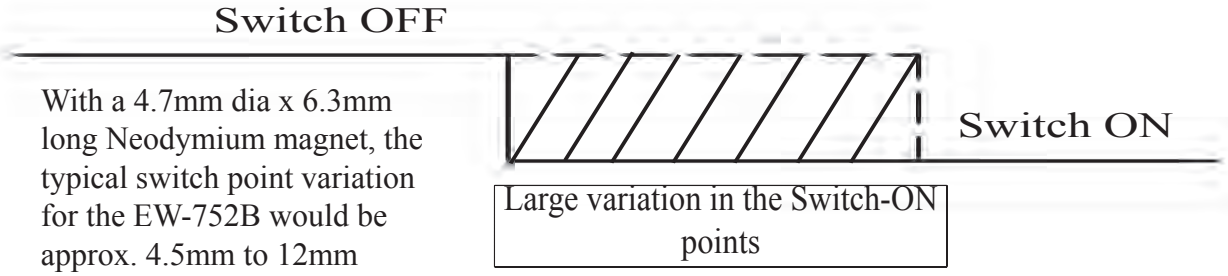
AKM Case Study: AKMCS-004
Non-Contact Accurate Switching with Hall IC's

The typical method of using a Hall switch activated by a magnet is to have the magnet approach the IC "Head ON". The magnetic field increases exponentially as it approaches the sensor. When the field exceeds the IC switch point Bop, the IC will turn ON. The problem with this method, is the Switch ON level, Bop, can vary significantly (4mT to 10mT for the EW-752B), therefore the switch ON point can have a wide range of operation as shown below becuase it operates on the low slope of the magnetic field curve. This method would not provide an accurate switch point.







With a 4.7mm dia x 6.3mm long Neodymium magnet, the typical switch point variation for the EW-752B would be approx. 4.5mm to 12mm

Large variation in the Switch-ON points

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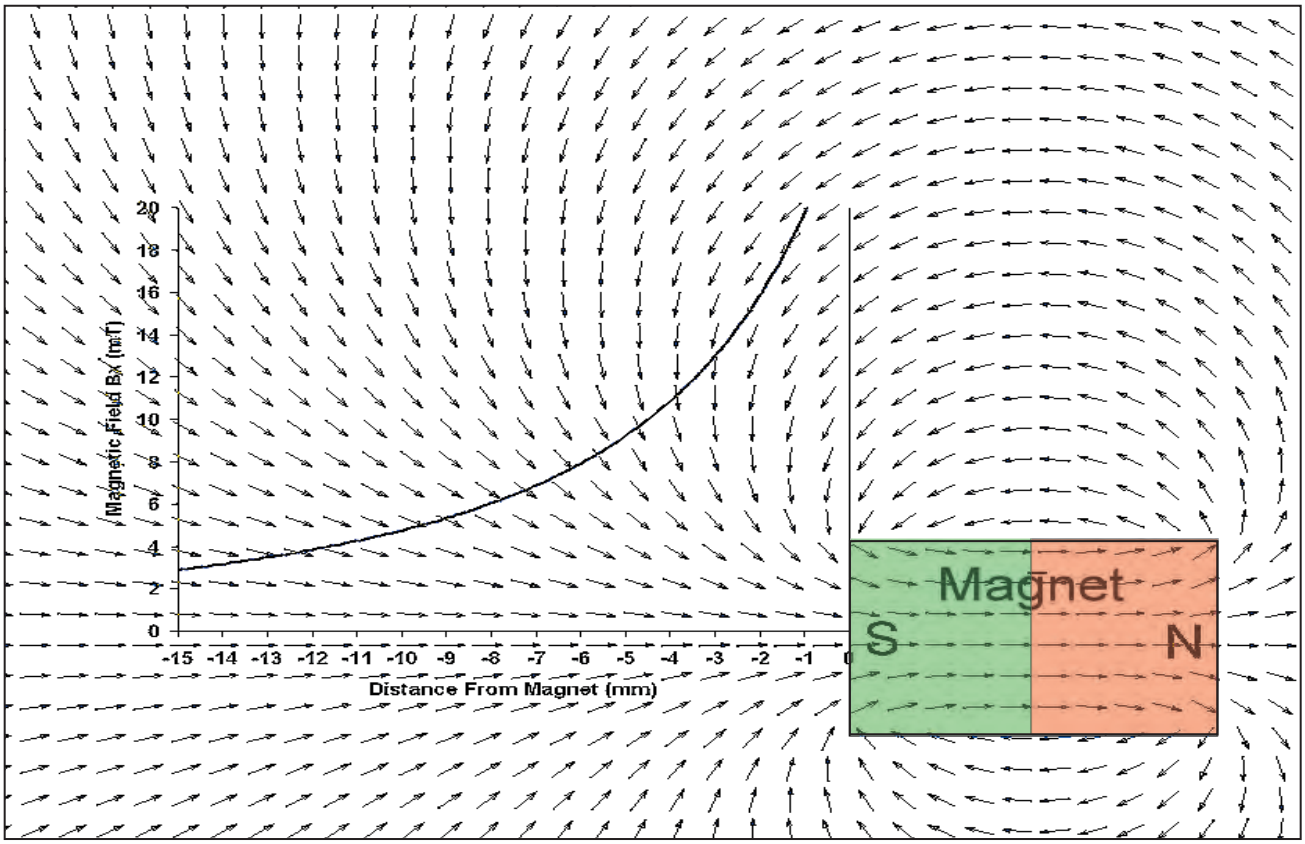
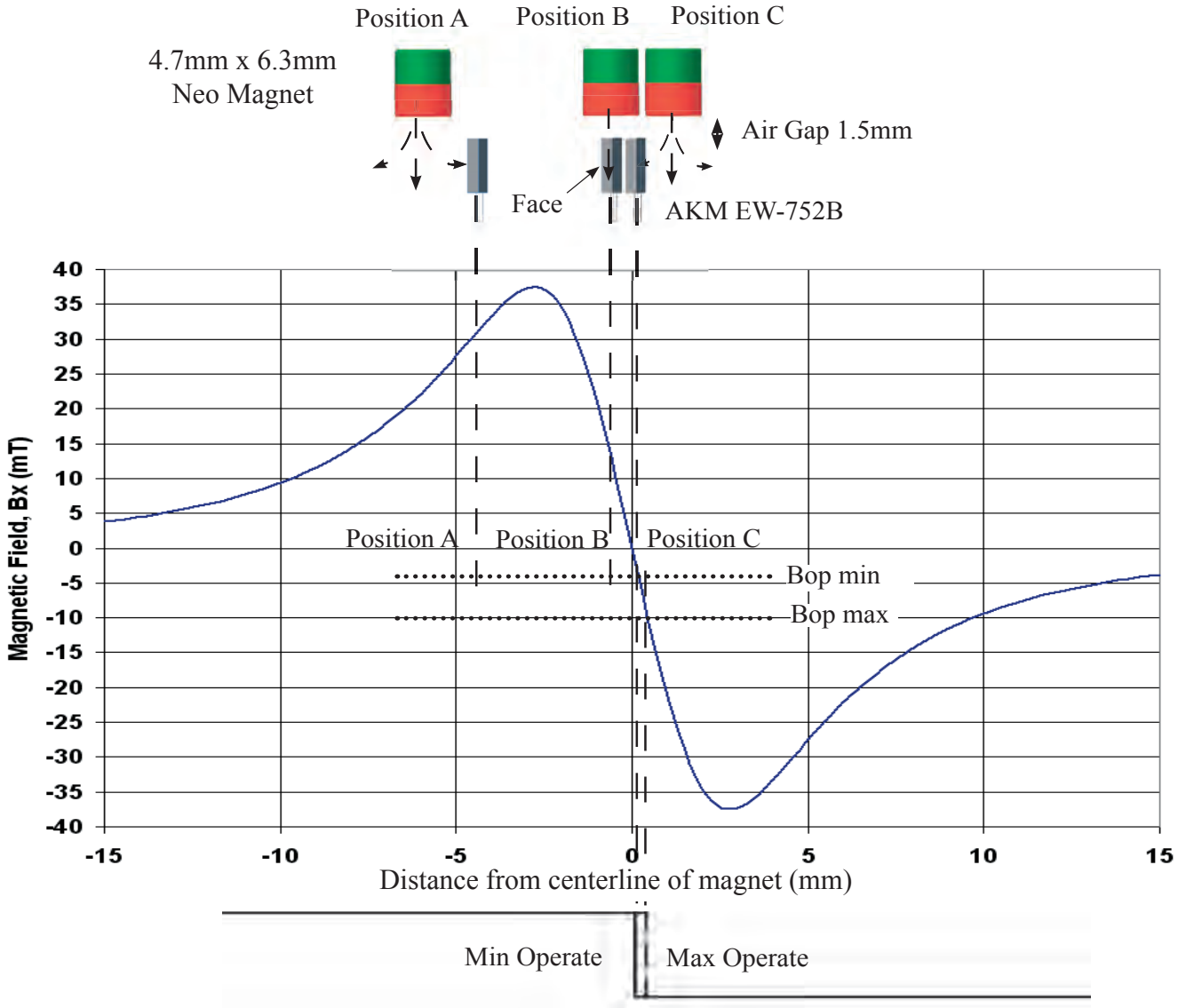
Below is the arrow plot as a result of magnetic modeling analysis of the magnet. The exponential curve in the plot below represents the field strength in the "X" direction as a function of distance from the magnet face



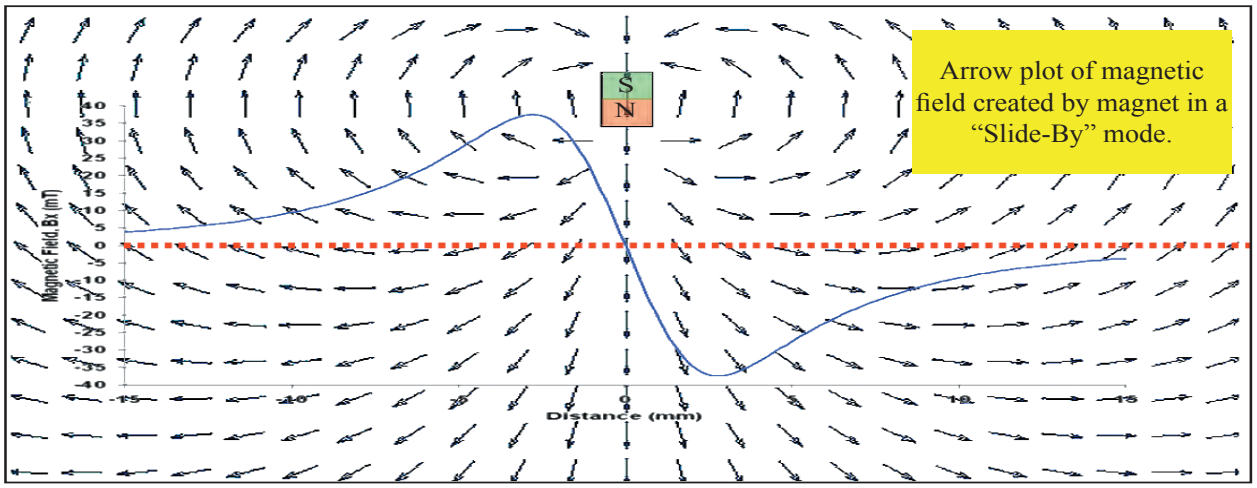
TECHNIQUE FOR IMPROVING SWITCHING POINT PRECISION

The best way to create an accurate switch point with a Hall switch IC, is to operate it in "Slide-By" mode. IN a "Slide-By" mode, the magnet passes by the sensor with the magnet pointing toward the top of the IC rather than the face of the IC. The illustration below shows the magnetic field as related to three different positions between the magnet and the IC. As the magnet approaches the IC, the magnetic field into the IC increases the field in the North direction (position A). As it passes over the IC , the field rapidly changes direction and passes through zero toward the South direction (Position B). As the field increases in the South direction, the IC responds to a South pole switch point, Bop and turns ON as shown in Position C. The "key" in obtaining an accurate switch point is operating the sensor in the steep portion of the field change. In this case, the variances in the Bop point from sensor to sensor, is very minimal. The stronger the magnet and the closer the sensor is to the magnet, the steeper the curve and therefore the more accurate the switch point will be.

AKM Case Study: AKMCS-004
Non-Contact Accurate Switching with Hall IC's



Variation < 0.5mm compared to 8mm variation with a "Head ON" approach



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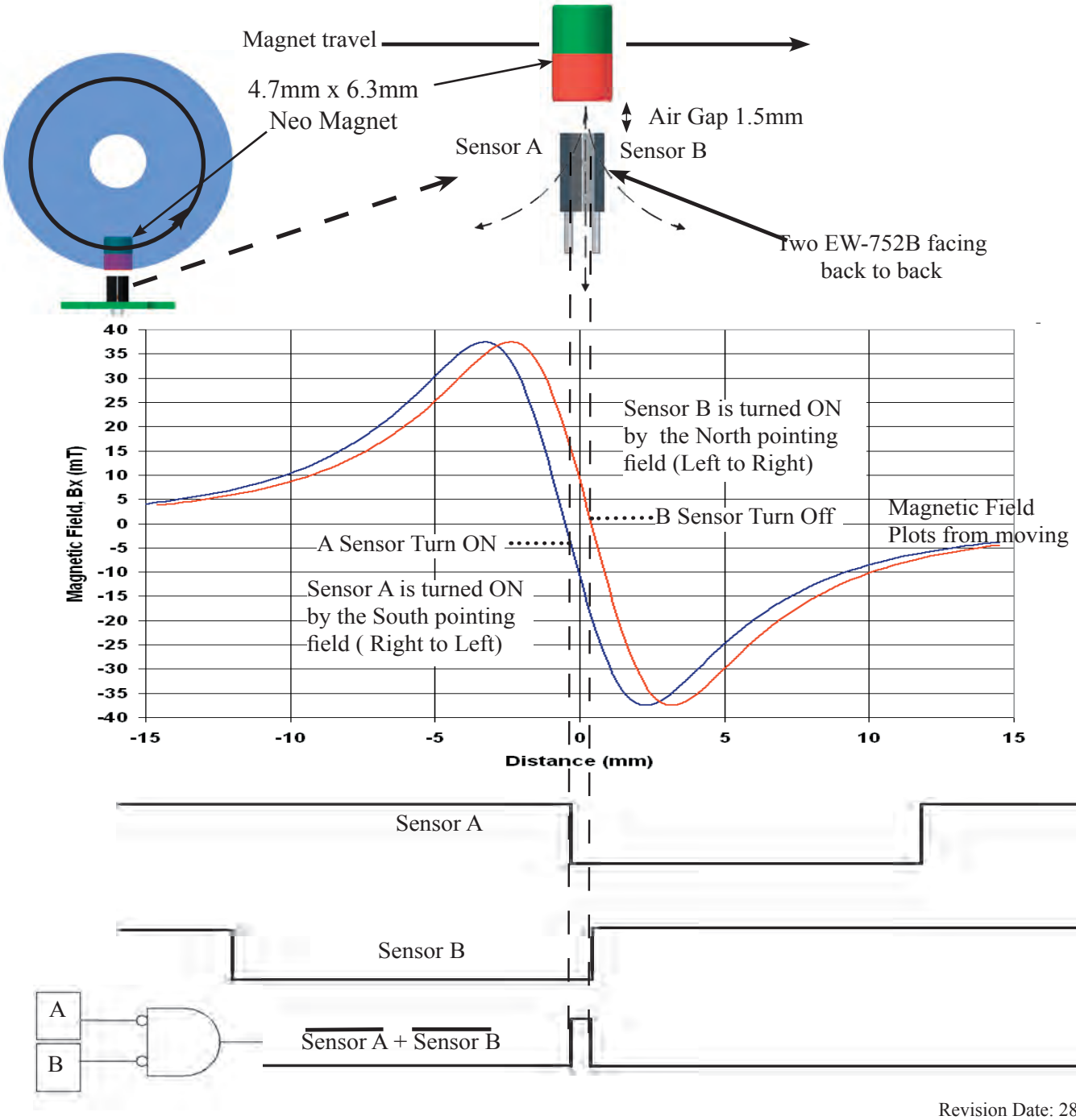
TOP DEAD CENTER SENSING

This technique is also very useful in creating a very narrow "Top Dead Center " timing pulse. This is accomplished by placing two EW-752B IC's back to back and having one switch turn ON just before the other IC is Turned Off. By combining the two outputs when they are both ON using a NAND gate, a very narrow and very accurate pulse can be created.. The width of the pulse is based on the distance between two sensors which is about 1mm when they are placed back to back. For a linear movement, the pulse width in seconds, would be the speed of the magnet in Sec/mm * 1mm. The physical width would be 1mm. For an angle sweep, the pulse width in degrees would be: $\Delta\theta \approx (1mm * 360^o)/\pi * D(mm)$ EG: for D=50mm, $\Delta\theta \sim (1mm * 360^o)/\pi * 50mm) \sim 2.3°$



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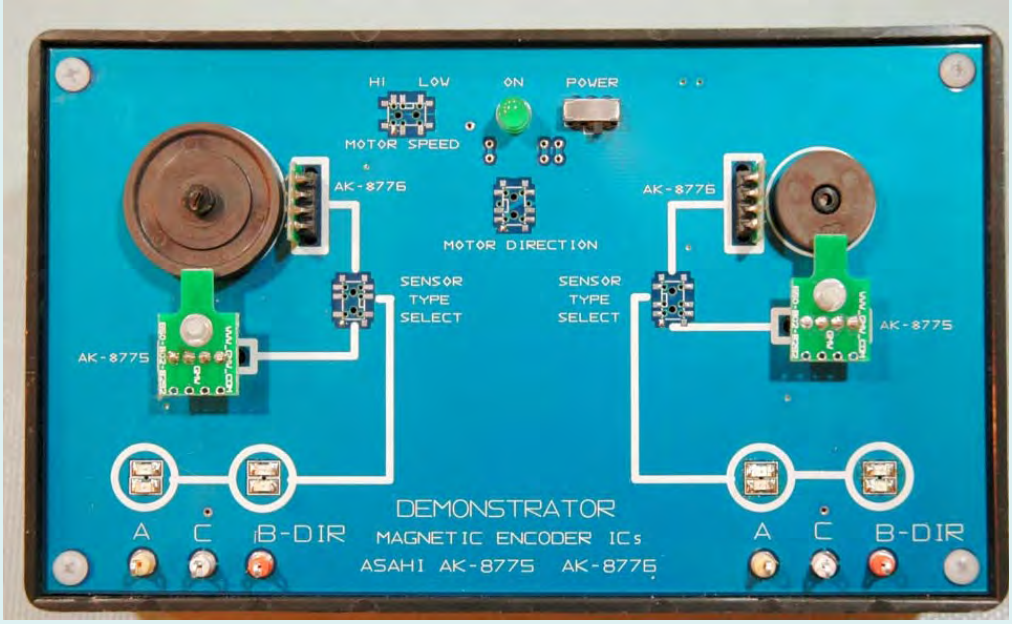
Demonstrator for the AKM AK8775
ands AK8776 Magnetic Encoder IC’s



Features:

- Self Contained 9V Battery Operated – Power ON/OFF switch
- Output LED indicators
- Motor driven ring magnets 4PP and 8PP
- Two Speed Switch
- Forward – Reverse Switch
- Output terminals for external connections and monitoring

AKM Magnetic Encoder IC Demonstrator

GMW Associates www.gmw.com 650-802-8292

Price List

AKM Hall Element KITs

- **AN_161KITs..... $35**
- **AN_160KIT Universal Hall Interface Amplifier..... $35**

Gapped Core Current Sensor KITs using the AKM EQ-73XL Series Linear ICs

- **AN_130KIT EQ-730L..... $35**
- **AN_131KIT EQ-731L..... $35**
- **AN_135KIT EQ-733L..... $35**
- **AN_136KIT EQ-733L..... $35**

CQ-121/131 Series Current Sensors KITS

- **AN_165KIT..... $35**

CQ-20XX Series Current Sensors KITS

- **AN_170KIT..... $35**

EM3242 Non-Contact Angle Sensor IC KITs

- **AN_133KIT..... $30**
- **AN_134KIT..... $30**

Demonstrators

- **AK8775/6 Encoder ICs..... $375**

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