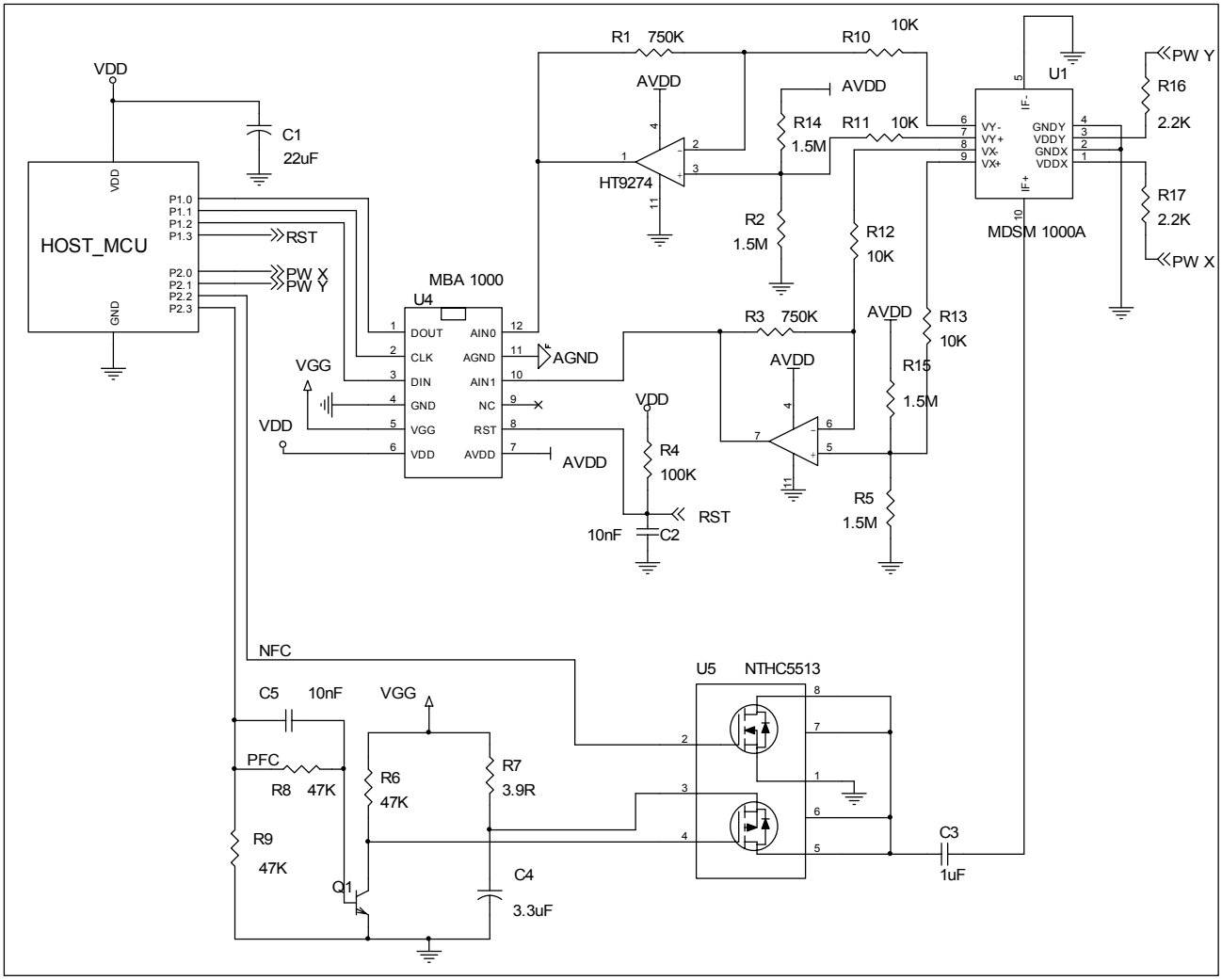
APPLICATION NOTE AN_MBA_01

COMPASS READING USING MBA-1000

Introduction

The MBA-1000 have two ADC input channels for user's external applications such as compass, humidity... This application note describes the recommended hardware and software for compass applications.

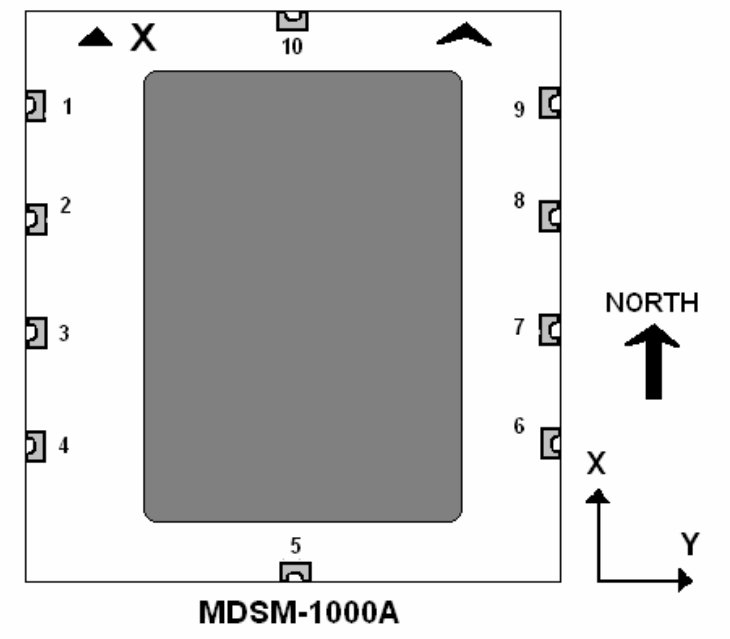
Compass application schematics:



Notes:

- PW X, PW Y: Positive power supply for X and Y sensor of MDSM-1000A. Each of them must have ability to supply an output source current greater than 1.5mA. To power off each sensor, the appropriated ports have to be set as HiZ.
- The order connected to AIN0 and AIN1 have to be kept as in schematics. AIN1 has to be connected to signal from X sensor and AIN0 to signal from Y sensor.
- AGND, AVDD: ground and power supply terminal for analog block. Their voltage are 1.8V and 3.6V to GND. Do not connect any extra capacitor between these pins to GND.
- The opamp used for amplifying must have rail-to-rail inputs and outputs.
- VGG: supply voltage for flip circuit. Its voltage is about two times than VDD.
- PFC, NFC: positive and negative flip control ports. These pins have not to be high at the same time, unless the power supply could be failed. Thus, P2.0 and P2.1 of host MCU must be output low or HiZ on resetting.
- R9 is used to prevent PFC high in case it is set as input on resetting. Its value could be changed depending on the internal pull-up resistor of P2.1 when it is set as input.
- The flip pulse measured at pin IF+ of MDSM-1000A must be greater than 3V peak and discharge to zero in more than 5us.

Compass direction:



MDSM-1000A

Software:

AD channel settings:

(Referring to section "AD channel 0 and AD channel 1 settings" in DS MBA-1000-rev 3_1)

- The external AD channels should be configured on Power-on or each time resetting the module.
- To configure AD for compass applications, the host MCU send code 4Ah and 2 bytes data: 00 29h (T_cv = 30ms, ADG1=ADG2=2)

AD compass reading:

(Referring to section "AD channel 0 and AD channel 1 reading" in DS MBA-1000-rev 3_1)

1. Send code 48H and wait 15ms, check for DOUT=1
2. Set PFC=1, power on X sensor, send a CLK to start converting Positive ADCX.
3. Delay 30ms, check for DOUT=1
4. Set PFC=0, power off X sensor (set PW X to HiZ), power on Y sensor, send a CLK to start converting Positive ADCY.
5. Delay 30ms, check for DOUT=1
6. Set NFC=1, send a CLK to start converting Negative ADCY.
7. Delay 30ms, check for DOUT=1
8. Set NFC=0, Power off Y sensor (set PW Y to HiZ), power on X sensor, send a CLK to start converting Negative ADCX.
9. Delay 30ms, check for DOUT=1
10. Power off X sensor (set PWX to HiZ).
11. Read 2 bytes ADCX data return from MBA-1000
    ADCX = (Negative ADCX – Positive ADCX).
12. Read 2 bytes ADCY data return from MBA-1000
    ADCY = (Negative ADCY – Positive ADCY).

Calibration:

Find the max and min value of ADCX and ADCY while rotating module in one cycle

1. Read the first value of ADCX and ADCY, store into MAXX, MAXY,MINX,MINY
2. Read ADCX and ADCY.
   If ADCX < MINX then MINX = ADCX
   If ADCX > MAXX then MAXX = ADCX
   If ADCY < MINY then MINY = ADCY
   If ADCY > MAXY then MAXY = ADCY
3. Delay 300ms.
4. Repeat from step 2 till Key Pressed or Time out
5. Calculate:
   XOFF = (XMAX+XMIN)/2
   YOFF = (YMAX+YMIN)/2
   XSC = XMAX – XMIN
   YSC = YMAX – YMIN
   K = (XSC * 256) / YSC

Note:

Because of delay time in step #3, the maximum ADC sample rate is 2 samples per sec. Thus, the module has to be turn very slowly while calibrating to obtain the accurate calibrated data.

Azimuth calculation:

1. Read ADCX and ADCY
2. Calculate:
   X= ADCX-XOFF
   Y= ADCY-YOFF
3. Check:
   |X| < (3 * XSC) / 4
   |Y| < (3 * YSC) / 4
   Unless, displaying error. The calibration has to be restarted.
4. If X = 0: |Azimuth|=90^{o} and go to Step 7
5. Calculate:
   Z= (|Y| * K) / |X|
6. Calculate |Azimuth| by comparing Z in range **[Zmin, Zmax)** showing in the following Table

Z min	Z max	Azimuth		Z min	Z max	Azimuth		Z min	Z max	Azimuth
0	2	0		145	151	30		435	452	60
2	7	1		151	157	31		452	471	61
7	11	2		157	163	32		471	492	62
11	16	3		163	169	33		492	513	63
16	20	4		169	176	34		513	537	64
20	25	5		176	183	35		537	562	65
25	29	6		183	189	36		562	589	66
29	34	7		189	196	37		589	618	67
34	38	8		196	204	38		618	650	68
38	43	9		204	211	39		650	685	69
43	47	10		211	219	40		685	723	70
47	52	11		219	226	41		723	765	71
52	57	12		226	235	42		765	812	72
57	61	13		235	243	43		812	864	73
61	66	14		243	252	44		864	923	74
66	71	15		252	261	45		923	990	75
71	76	16		261	270	46		990	1066	76
76	81	17		270	279	47		1066	1155	77
81	86	18		279	289	48		1155	1258	78
86	91	19		289	300	49		1258	1381	79
91	96	20		300	311	50		1381	1530	80
96	101	21		311	322	51		1530	1713	81
101	106	22		322	334	52		1713	1945	82
106	111	23		334	346	53		1945	2247	83
111	117	24		346	359	54		2247	2659	84
117	122	25		359	372	55		2659	3253	85
122	128	26		372	387	56		3253	4186	86
128	133	27		387	402	57		4186	5863	87
133	139	28		402	418	58		5863	9776	88
139	145	29		418	435	59		9776	29335	89
								29335		90

7. Calculate the real Azimuth as the following table:

	Y ≥ 0	Y < 0
X ≥ 0	Azimuth=180^o - |Azimuth|	Azimuth=180^o + |Azimuth|
X <0	Azimuth= |Azimuth|	Azimuth= 360^o – |Azimuth|

Check if Azimuth=360^o then Azimuth=0^0 .

Notes:

- To calculate azimuth, user must have these functions:
  - Addition: 16 bit + 16bit
  - Subtraction: 16bit -16 bit
  - Multiple: unsigned 16 bit x unsigned 16 bit.
  - Division: unsigned 32 bit / unsigned 16bit.