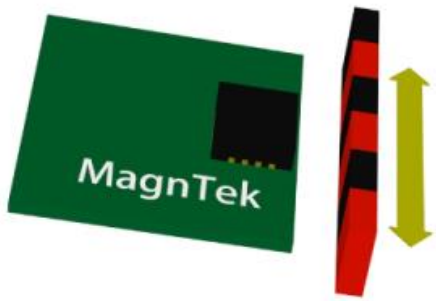
MT6828

Off-Axis Magnetic Angular Sensor IC

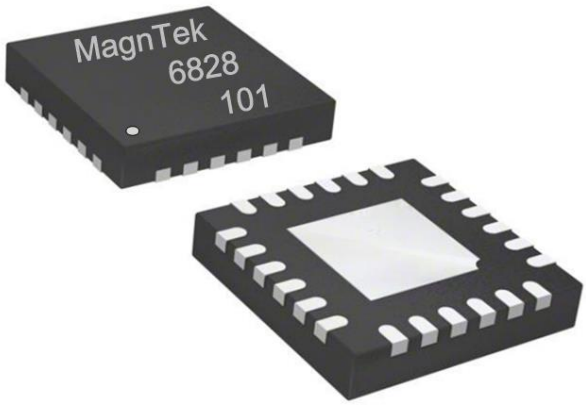
Features and Benefits

- Based on advanced AMR Technology with 0~360° Full Range Angle Sensing
- Off-Axis and On-Axis Applications
- 17-bit Core Resolution
- Maximum Rotation Speed 120,000/N RPM (N is the pole pairs of Magnetic Ring or Tape)
- Output Propagation Delay <10 us
- Output Interface: ABZ、PWM or SPI
- ABZ Resolution 1~1,024 Pulses per Revolution (PPR) User Programmable
- RoHS Compliant 2011/65/EU



Applications

- General Angle Position Measurement
- BLDC Motor Control
- Stepping or Servo Motor Control
- Robotics



General Description

MagnTek' s rotary position sensor MT6828 is an IC based on advanced AMR technology. A special designed AMR bridge enables MT6828 to be suitable for not only On-Axis applications, but also Off-Axis applications.

The sensing element output is specially designed to be independent from the magnet field strength. This allows the device to be less sensitive to magnet variations, stray magnetic fields, air gap changes and misalignment.

The incremental ABZ output mode is available in this sensor series, making the chip suitable to replace various optical encoders. The maximum resolution is 4096 steps or 1024 pulses per revolution

A standard 4-Wire SPI interface allows a host microcontroller to read out the 17-bit absolute angle position data from MT6828. The absolute angle position is also provided as a 12-bit PWM output.

Table of Contents

1. Pin Configuration

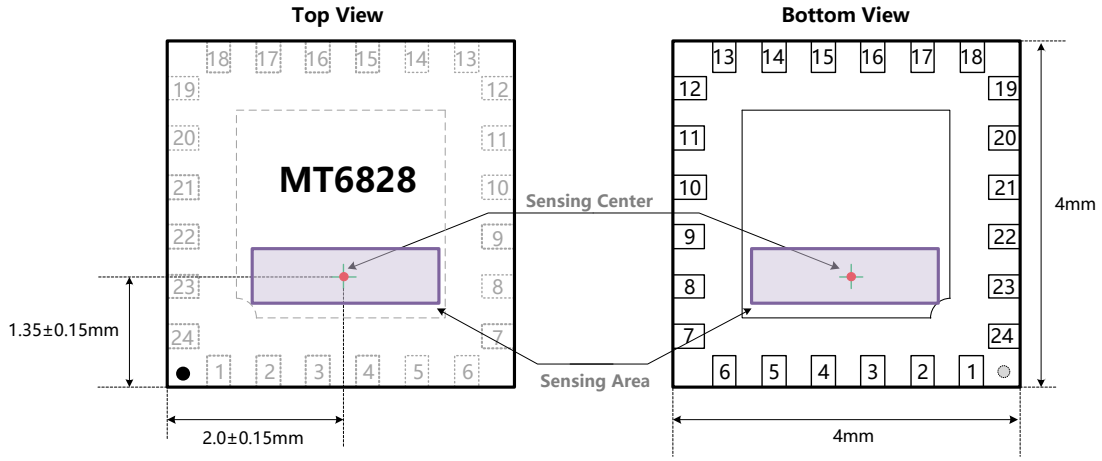


Figure-1: Pin Configuration of MT6828 (QFN4x4-24L) Package

Pin List

Name	#	Type	Description
W	1	Digital Output	Commutation Signal W
U	2	Digital Output	Commutation Signal U
V	3	Digital Output	Commutation Signal V
MISO	4	Digital Output	SPI MISO
MOSI	5	Digital Input	SPI MOSI
SCK	6	Digital Input	SPI Clock
CSN	7	Digital Input	SPI Chip Select
NA	8~10	-	Not Connected
VDD	11	Power Supply	3.3~5.0V Supply
OUT	12	Digital Output	PWM Output
TEST	13	Analog Input	Factory Test Pin
VSS	14	Power Supply	Ground
TEST_EN	15	Digital Output	Factory Test Enable
Z	16	Digital Output	Incremental Signal Z
B	17	Digital Output	Incremental Signal B
A	18	Digital Output	Incremental Signal A
NA	19	-	Not Connected
CAL_EN	20	Digital Input	Auto Calibration Enable Pin
NA	21~24	-	Not Connected

Family Members

Part Number	Description
MT6828JT-STD	QFN4x4-24L Package, Tape & Reel Pack (1000pcs/Reel)

MT6828 QFN Package Reflow Sensitivity Classification: MSL-3

2. Functional Diagram

The MT6828 is manufactured in a CMOS standard process and uses advanced magnet sensing technology to sense the magnetic field distribution across the surface of the chip. The integrated magnetic sensing element array is placed around the center of the device and delivers a voltage representation of the magnetic field at the surface of the IC.

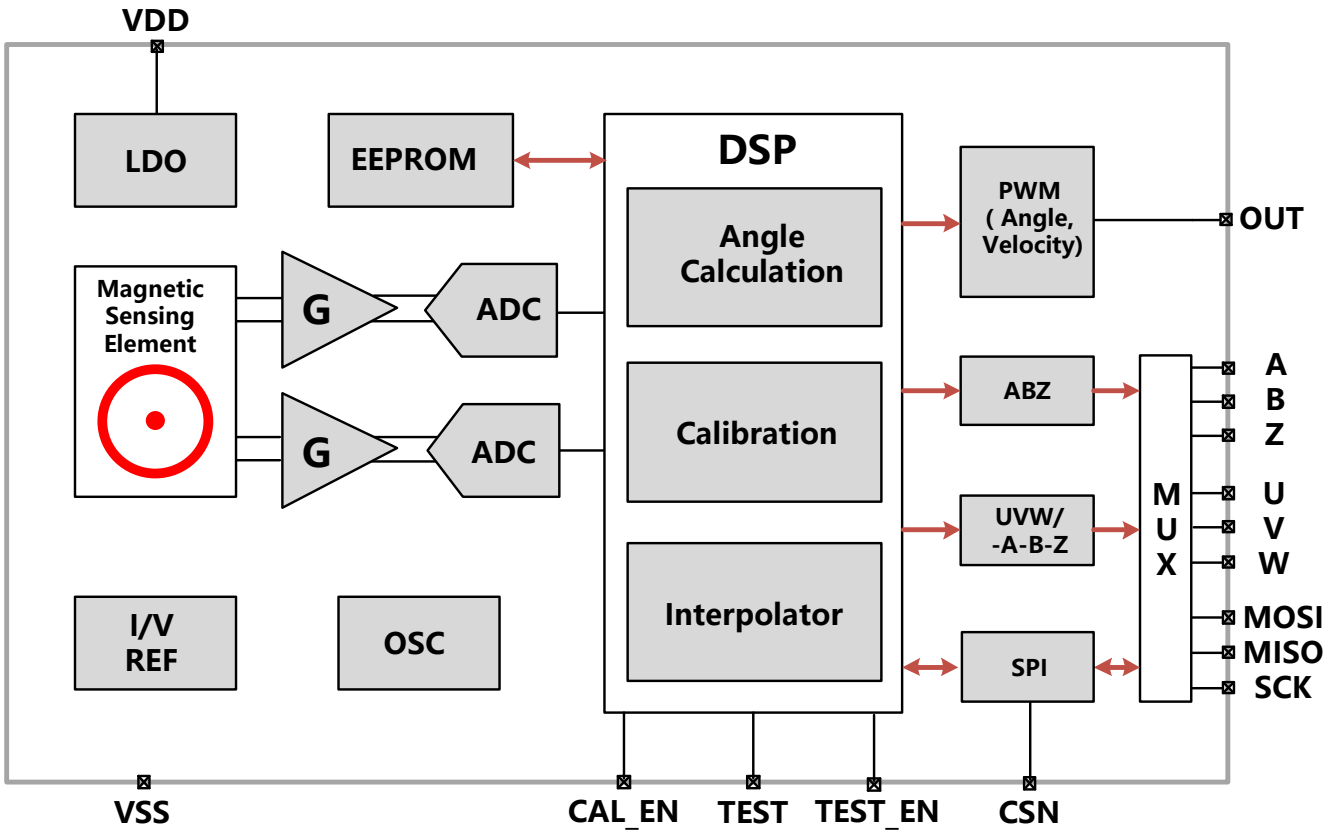


Figure-2: Block Diagram

Figure-2 shows a simplified block diagram of the chip, consisting of the magnetic sensing element modeled by two interleaved Wheatstone bridges to generate cosine and sine signals, gain stages, analog-to-digital converters (ADC) for signal conditioning, and a digital signal processing (DSP) unit for encoding. Other supporting blocks such as LDO, etc. are also included.

3. Absolute Maximum Ratings (Non-Operating)

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under "Operating Conditions" is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameter	Min.	Max.	Unit	Notes
DC Voltage at Pin VDD	-0.5	6.5	V	
Terminal Voltage at Input and Output Pins	-0.5	VDD	V	ABZ, UVW, MISO, MOSI, SCK, CSN, TEST_EN, OUT, CAL_EN
Output Current at Output Pins	-20	20	mA	ABZ, UVW, OUT, MISO
Storage Temperature	-40	150	℃	
I_{SCR} (Latch-up Input Current)	-	±100	mA	AEC-Q100-004
V_{HBM} (ESD Voltage)	-	±6.0	KV	AEC-Q100-002
V_{CDM} (ESD Voltage)	-	±1.5	KV	AEC-Q100-011

4. Operating Conditions

Parameter	Min.	Max.	Unit
DC Voltage at Pin VDD	3.0	5.5	V
Magnetic Flux Density Range	30	1,000	mT
Rotation Speed	-	120,000	RPM
Operating Temperature	-40	125	℃

5. Electrical Characteristics

Operation conditions: Ta=-40 to 125℃, VDD=3.0~5.5V unless otherwise noted.

Symbol	Parameter	Conditions/Notes	Min.	Typ.	Max.	Unit
VDD	Supply Voltage	-	3.0	3.3~5.0	5.5	V
Idd	Supply Current	-	15	22	28	mA
LSB	Resolution (ABZ Mode)	N Steps per Cycle	-	360°/N	-	°
INL	Integral Non-Linearity	**Note[1]**	-	±1.0	±1.5	°
DNL	Differential Non-Linearity (ABZ Mode), **Figure-3**	@2500 PPR	-	±0.01	-	°
TN	Transition Noise (ABZ Mode)	25℃	-	0.01	-	°rms
Hyst	Hysteresis (ABZ Mode)		-	0.022	-	°
T_{PwrUp}	Power-Up Time	VDD Ramp<100us	-	64	-	ms
T_{Delay}	Propagation Delay		-	-	10	us

Note[1]: The typical error value can be achieved at room temperature and with no off-axis misalignment error. The maximum error value can be achieved over operation temperature range, at maximum air gap and with worst-case off-axis misalignment error as shown in Figure-6.

PWM Output Characteristics

Operation conditions: Ta=-40 to 125℃, VDD=3.0~5.5V unless otherwise noted.

Symbol	Parameter	Conditions/Notes	Min.	Typ.	Max.	Unit
FPWM	PWM Frequency	Programmable	-8%	497/994	+8%	Hz
T_{Rise}	Rising Time	C_L=1nF	-	-	1	us
T_{Fall}	Falling Time	C_L=1nF	-	-	1	us

ABZ Output Characteristics

Operation conditions: Ta=-40 to 125℃, VDD=3.0~5.5V unless otherwise noted.

Symbol	Parameter	Conditions/Notes	Min.	Typ.	Max.	Unit
AB_{RES}	AB Resolution	Programmable	1	-	1,024	Pulse/Round
AB_{Freq}	A or B Frequency	**Note[2]**	-	-	2.048	MHz

Note[2]: The AB_{Freq} is the product of RS(Rotation Speed) and AB_{RES}. So, for maximum AB resolution of 1,024 PPR with N pole-pairs magnetic ring , the maximum supported rotation speed RS is:

$$RS_{MAX} = \frac{AB_{Freq}}{AB_{Res}} = \frac{2.048MHz}{1,024} = 2,000Hz = 12,0000 / N \quad \textbf{RPM}$$

Digital I/O Characteristics

Operation conditions: Ta=-40 to 125℃, VDD=3.0~5.5V unless otherwise noted.

Symbol	Parameter	Conditions/Notes	Min.	Typ.	Max.	Unit
V_{IH}	High Level Input Voltage	-	0.7*VDD	-	-	V
V_{IL}	Low Level Input Voltage	-	-	-	0.3*VDD	V
V_{OH}	GPIO Output High Level	Push-Pull (Iout=-2mA)	VDD-0.4	-	-	V
V_{OL}	GPIO Output Low Level	Push-Pull (Iout=2mA)	-	-	0.4	V

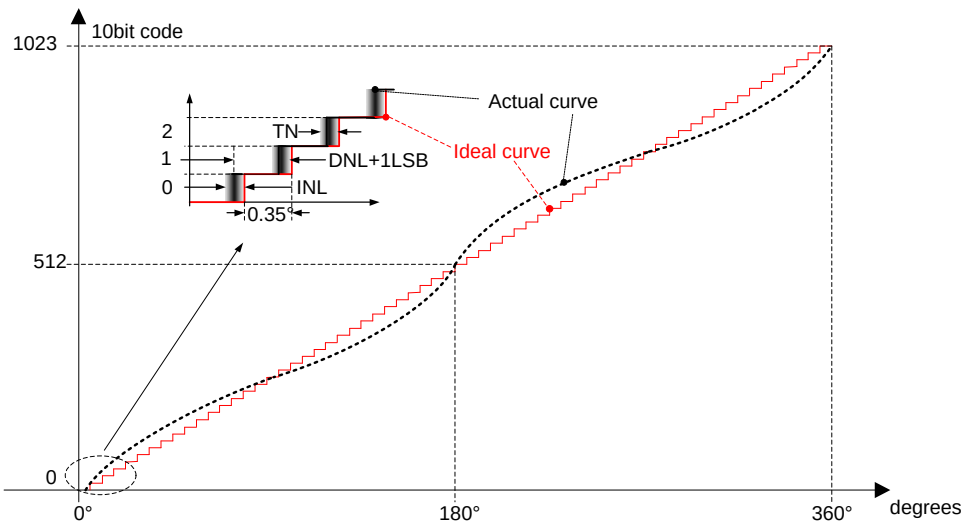


Figure-3: Drawing Illustration INL, DNL and TN (for 10-bit case)

6. Magnetic Input Specifications

The MT6828 is designed for off-Axis applications, the sensor can be positioned away from the rotation axis of a magnetic ring, or a magnetic tape as shown in Figure-4. In this case, the magnetic field angle is no longer directly proportional to the mechanical angle. The MT6828 can be adjusted to calibration for this effect and recover the linear relation between the mechanical angle and the sensor output. With multiple pole pair magnets, the MT6828 indicates multiple rotations for each mechanical turn.

Figure-4: Off-Axis Applications with Magnetic Ring or Tape

For off-Axis application we recommend that MT6828 and the magnetic ring placed as shown in Figure-5.

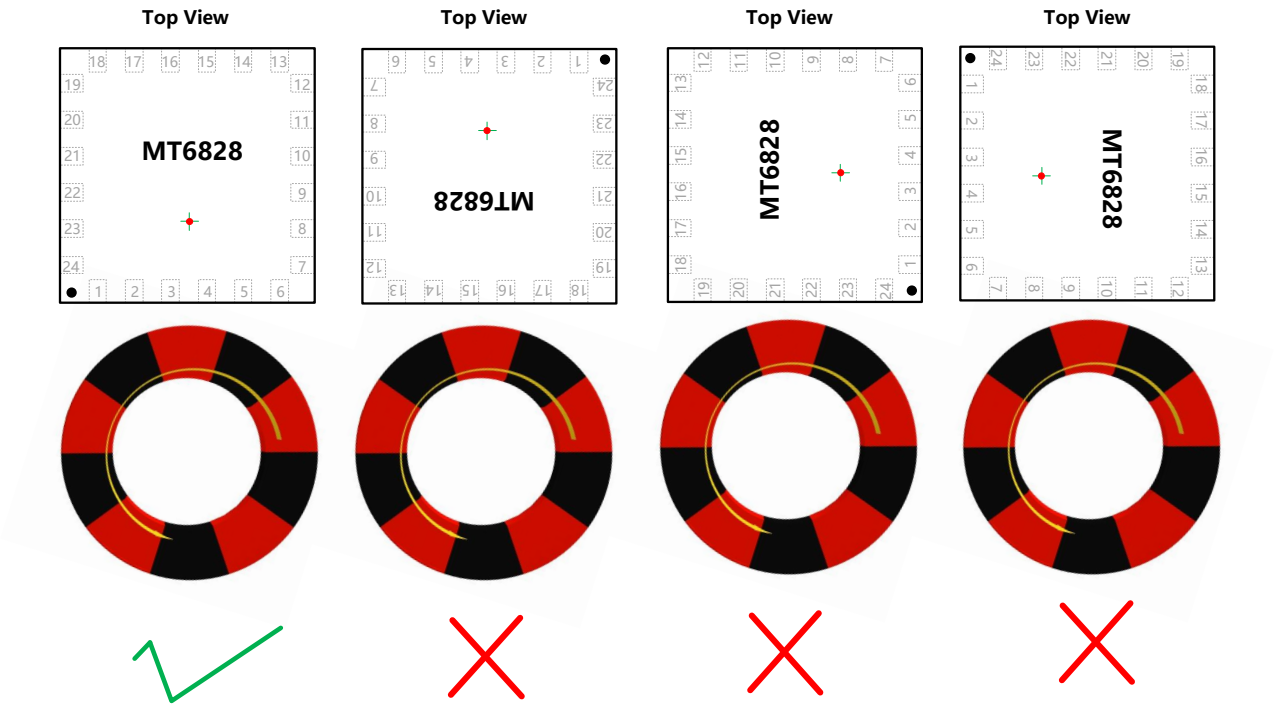


Figure-5: Off-Axis Magnetic Ring & MT6828 Placement

Operation conditions: Ta=-40 to 125℃, VDD=3.0~5.5V unless otherwise noted, cylindrical diametrically magnetized ring or tape.

Symbol	Parameter	Conditions/Notes	Min.	Typ.	Max.	Unit
Bpk	Magnetic Input Field Amplitude	Measure at the IC Surface	30	-	1,000	mT
AG	Air Gap	Magnetic to IC Surface Distance	-	1.0	2.0	mm
RS	Rotation Speed	One Pole-Pair Magnet	-	-	120,000	RPM
DISP	Misalignment	Misalignment Error Between Sensor Sensing Center and Magnet Axis (See Figure-6)	-	-	0.2	mm
TCmag1	Recommended Magnet Material and Temperature Drift Coefficient	NdFeB (Neodymium Iron Boron)	-	-0.12	-	%/℃
TCmag2		SmCo (Samarium Cobalt)	-	-0.035	-	

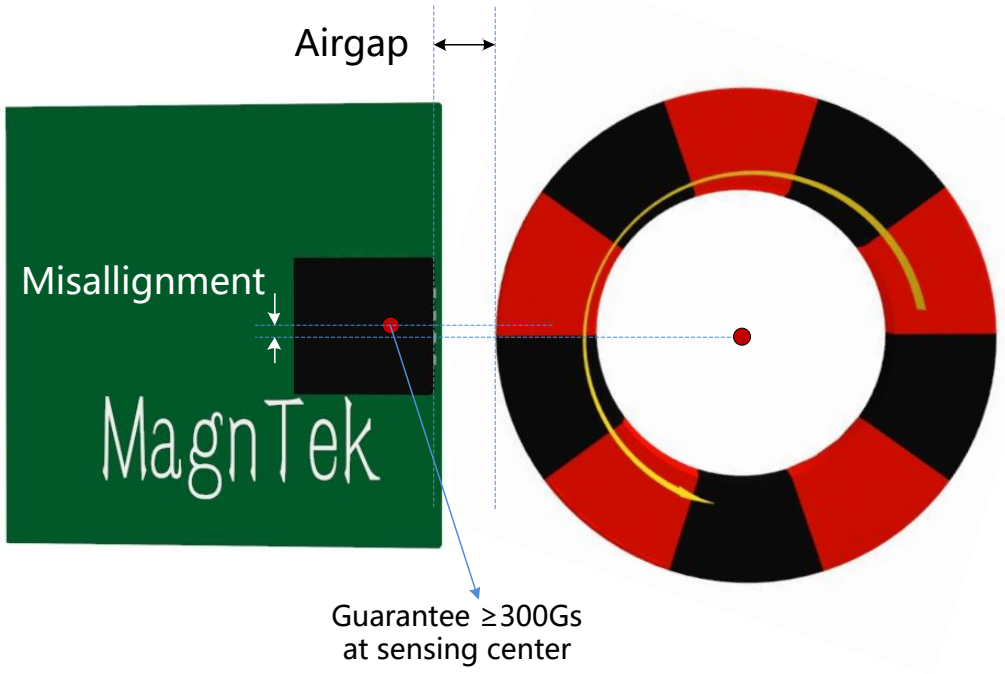


Figure-6: Magnet Arrangement

7. Output Mode

The MT6828 provides ABZ, UVW and PWM signals at output pins, and the 17-bit absolute angle position data could be transferred by the standard 4-Wire SPI interface.

7.1 I/O Pin Configuration

For QFN4x4-24L package, ABZ (Single-end or Differential), UVW, PWM and SPI Interface are configured as below table.

I/O Pin Configuration

Pin#	UVW+SPI+PWM+ABZ	-A-B-Z+SPI+PWM+ABZ
1	W	-Z
2	U	-A
3	V	-B
4	MISO	MISO
5	MOSI	MOSI
6	SCK	SCK
7	CSN	CSN
12	OUT(PWM)	OUT(PWM)
16	Z	Z
17	B	B
18	A	A

7.2 Reference Circuit

The MT6828 is powered by a single supply VDD (3.3~5.0V), so a decoupling capacitor no less than 0.1uf between VDD and GND is necessary. For better EMC performance, we highly recommend adding a TVS between VDD and GND. The default reference circuit is shown in Figure-7.

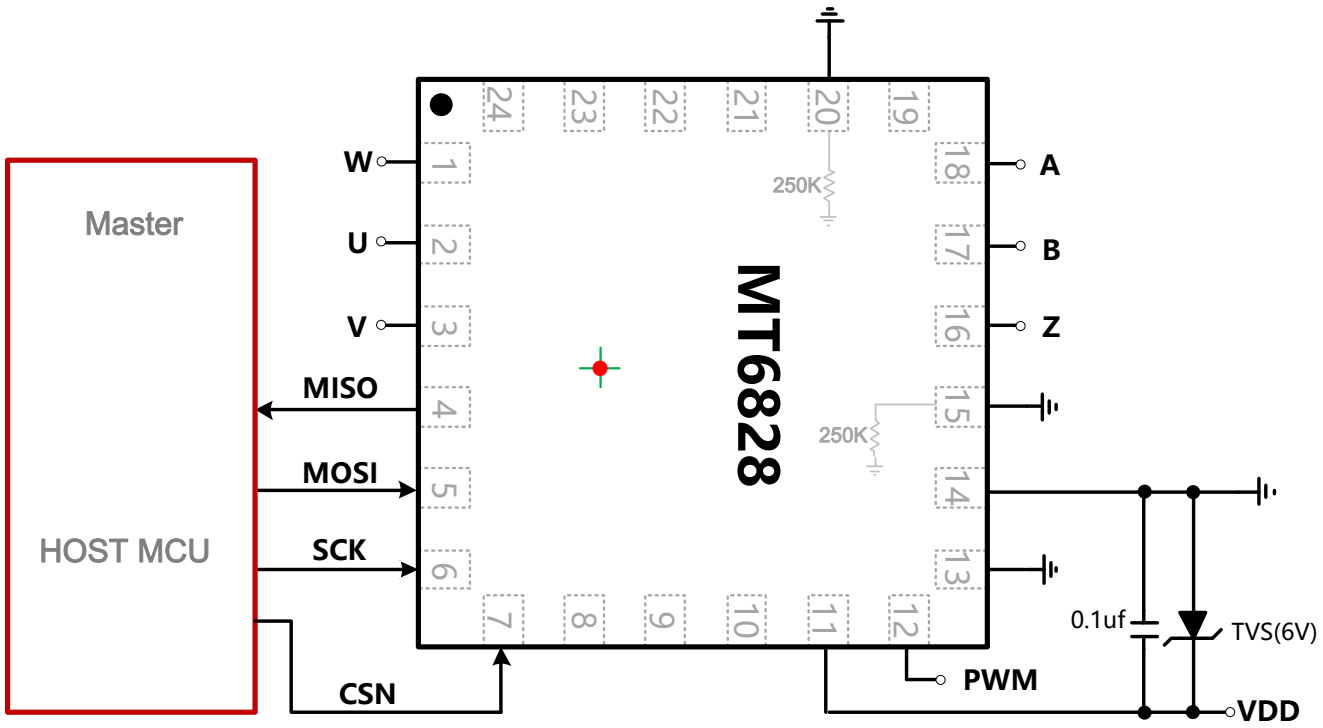
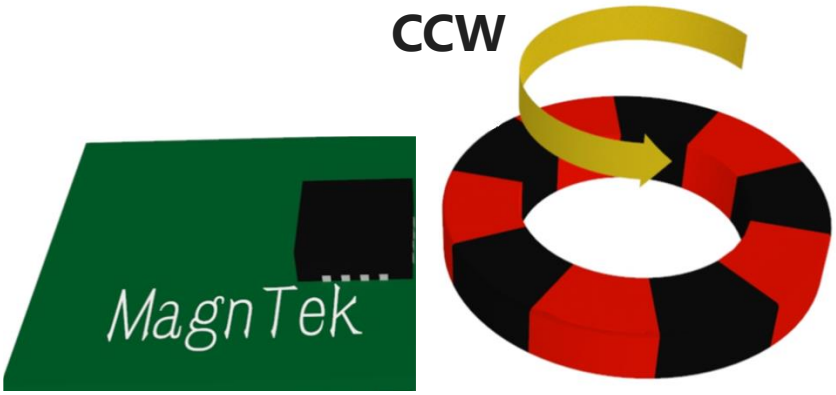


Figure-7: Reference Circuit

7.3 Quadrature A,B and Zero-Position Output (ABZ Mode)

As shown in Figure-8, when the magnet rotates counter-clock-wise (CCW), output B leads output A by 1/4 cycle, when the magnet rotates clock-wise (CW), output A leads output B by 1/4 cycle (or 1 LSB). Output Z indicates the zero position of the magnet. After chip power-on, the ABZ output is blocked for 64ms to guarantee proper output.



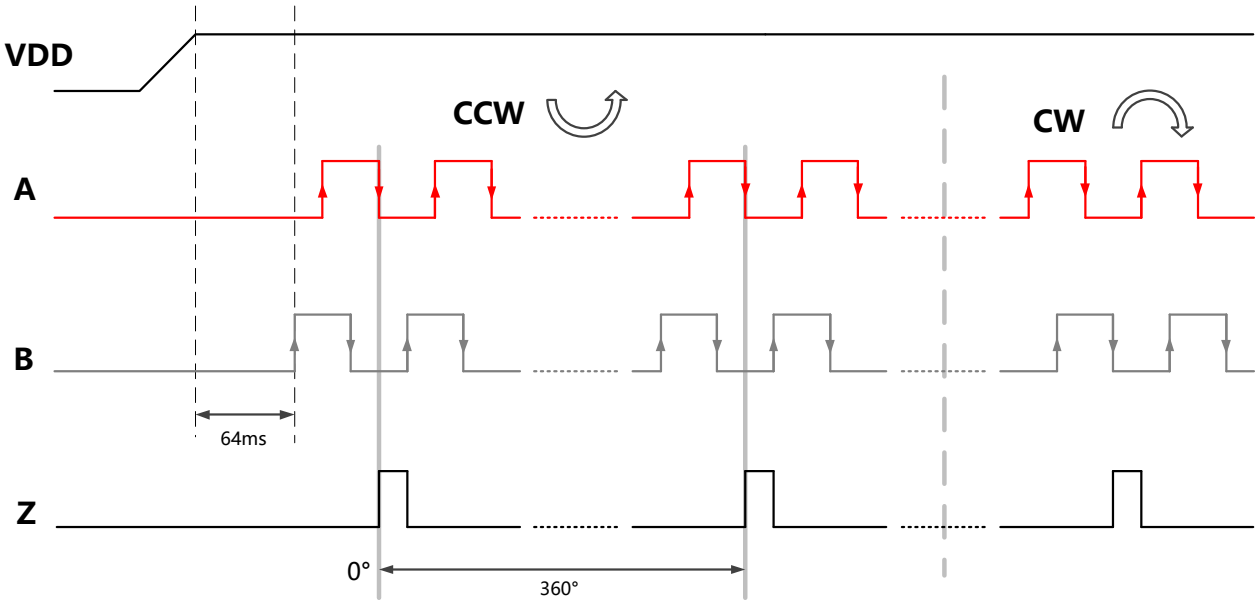


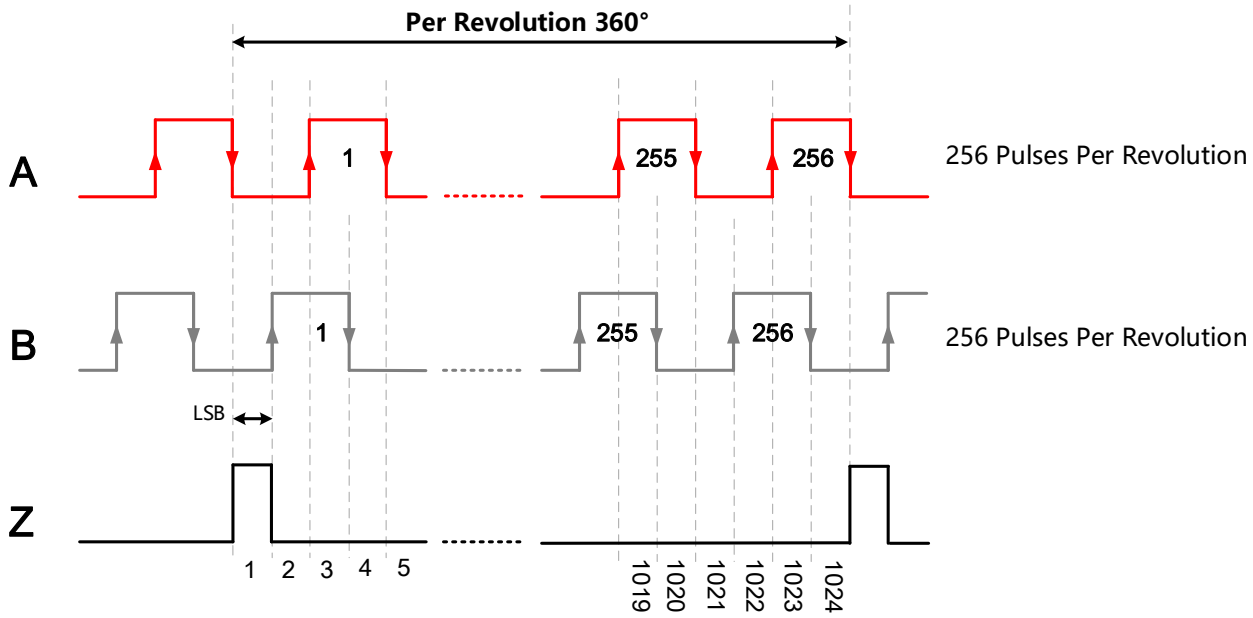
Figure-8: ABZ output with VDD power on

'Rotation-Dir' Register(EEPROM)

Reg. Rotation-Dir	Rotation Direction
0x0	Counter-Clockwise
0x1	Clockwise

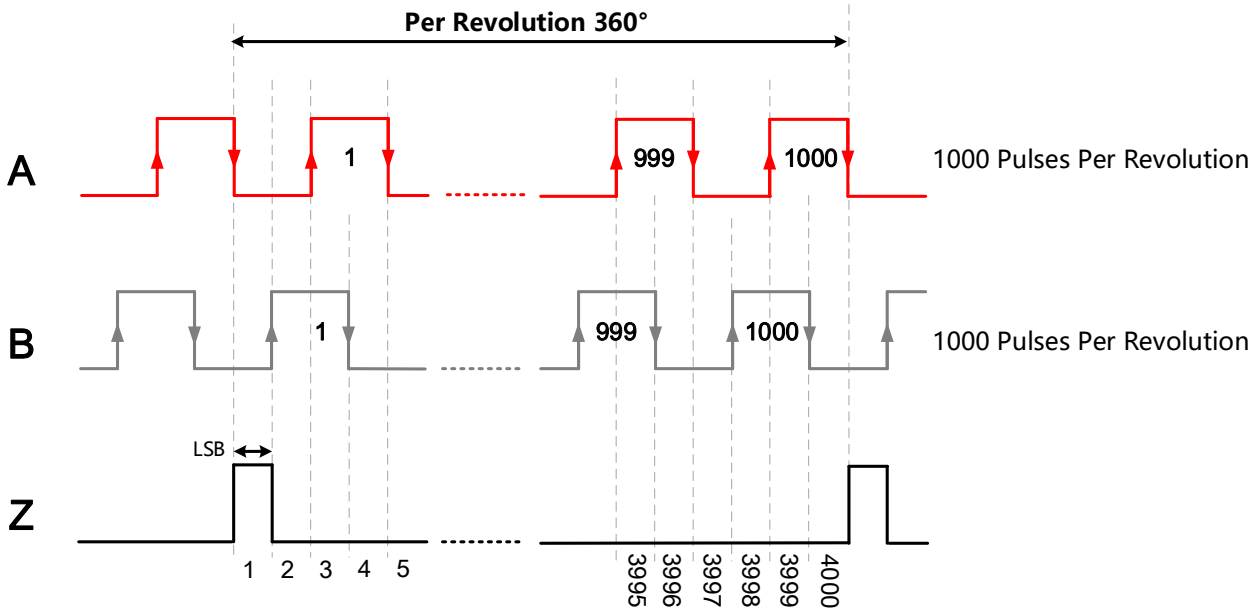
' ROT-DIR' is effective for all output types as ABZ, UVW, PWM and SPI Angle data

ABZ resolution is user programmable from 1~1,024 PPR. The relationship between binary bits, LSBs and PPR resolution of ABZ output are shown in Figure-9 & Figure-10.



10 bit=2^{10} LSBs=1024 Steps=256 PPR

Figure-9: ABZ Output Resolution=10 bit=256 PPR



1000 PPR=4000 Steps

Figure-10: ABZ Output Resolution=1,000 PPR

The resolution of ABZ is defined by a 12-bit register 'ABZ_RES[11:0]';

'ABZ_RES[11:0]' Register (EEPROM)

Reg. ABZ_RES[11:0]	AB Resolution (Pulse per. Round)
0x000	1
0x001	2
0x002	3
. . .	. . .
0x3FD	1,022
0x3FE	1,023
0x3FF	1,024
0x400~0xFFF	1,024

Output Z indicates the zero position of the magnet which is user programmable, and the pulse width of Z is selectable as 1, 2, 4, 8 as shown in Figure-10. It is guaranteed that one Z pulse is generated for every rotation.

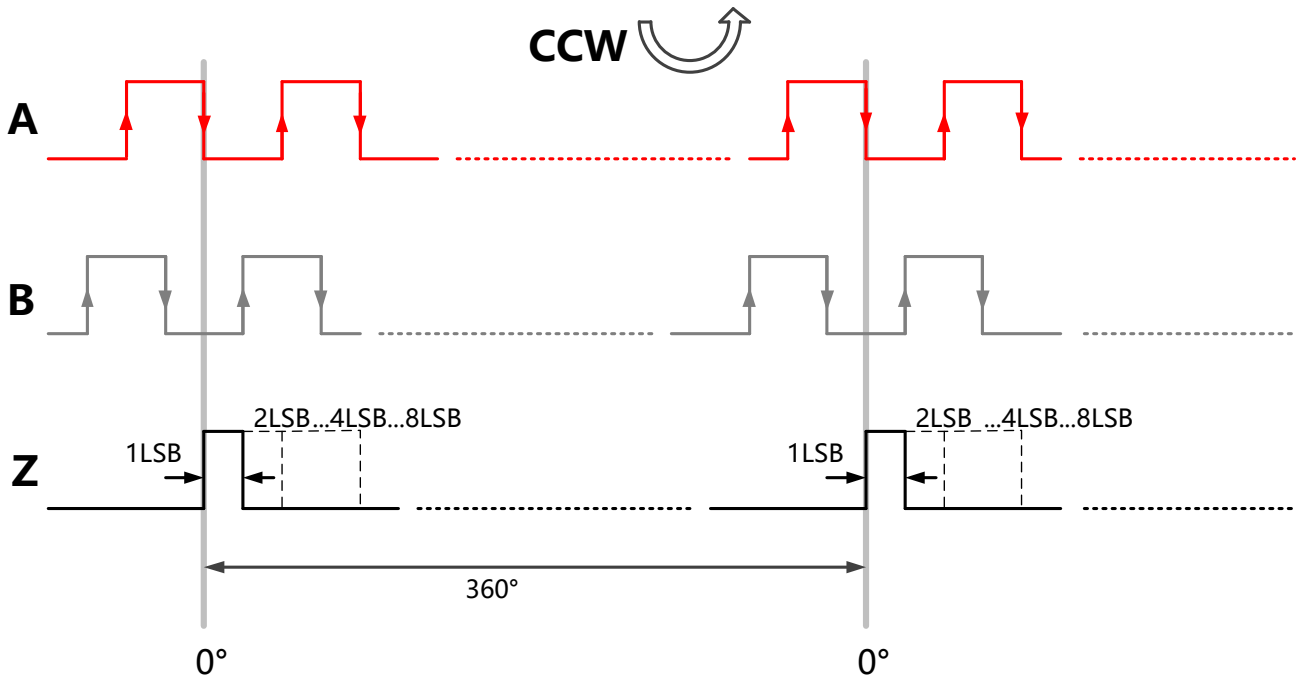


Figure-11: Typical ABZ Output w/i Z pules width=1,2,4 and 8 LSBs

The absolute position of Z pulse is defined by the 12-bit register 'ZERO_POS[11:0]';

'ZERO_POS' Register (EEPROM)

Reg. ZERO_POS[11:0]	Absolute Position (°)
0x000	0
0x001	0.088
0x002	0.176
… …	… …
0x3FE	359.824
0x3FF	359.912

7.4 UVW Output Mode

The MT6828 provides U, V and W pulses which are 120° (electrical) out of phase as shown in Figure-12. The cycles of UVW per rotation can be programmed.

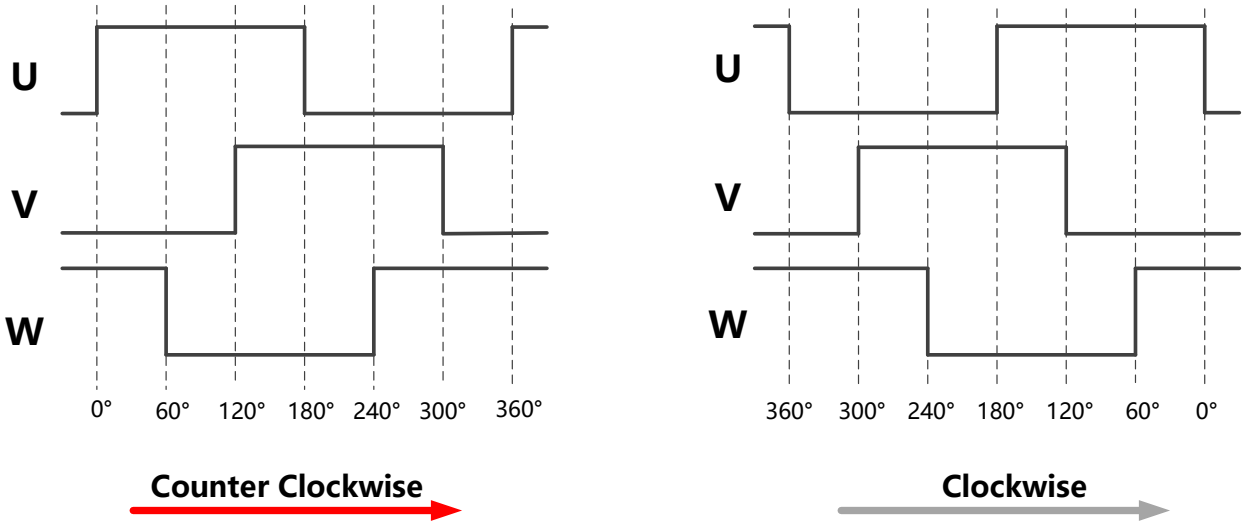


Figure-12: Typical Output Waveform for UVW Mode

'UVW_RES' Register (EEPROM)

Reg. UVW_RES[3:0]	UVW Pole Pairs
0x0	1
0x1	2
0x2	3
0x3	4
0x4	5
0x5	6
0x6	7
0x7	8
0x8	9
0x9	10
0xA	11
0xB	12
0xC	13
0xD	14
0xE	15
0xF	16

7.5 Pulse Width Modulation (PWM) Output Mode

The MT6828 provides a digital Pulse Width Modulation (PWM) output, whose duty cycle is proportional to the measured angle as shown in Figure-13. PWM is a default output of Pin.12.

The PWM output consists of a frame of 4119 PWM clock periods. The angle data is represented with 12-bit resolution in the frame. One PWM clock period represents 0.088° and has a typical duration of 244ns which also could be programmed to be 488ns.

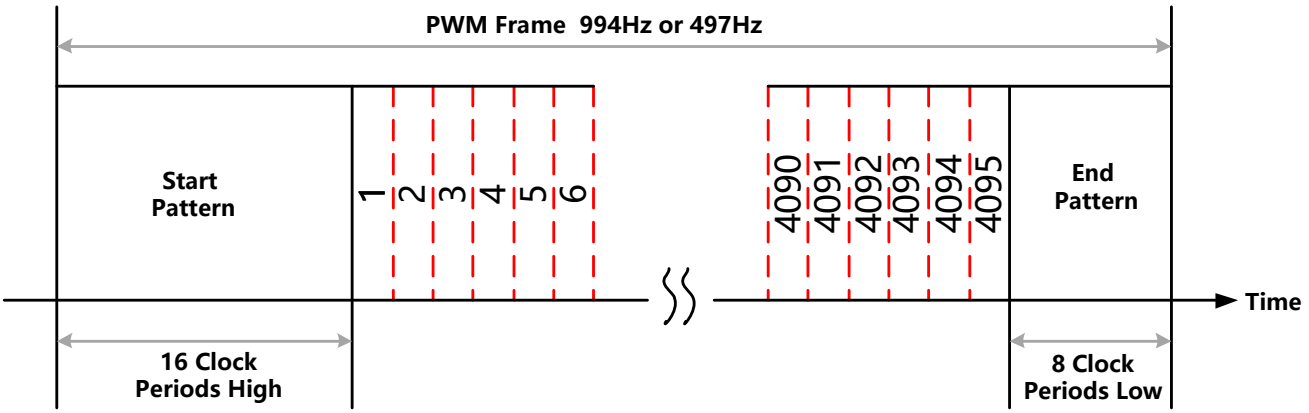


Figure-13: PWM Output Frame

'PWM_FQ' Register (EEPROM)

Reg. PWM_FQ	PWM Frame Frequency
0x0	994 Hz
0x1	497 Hz

'PWM_SEL[2:0]' Register (EEPROM)

Reg. PWM_SEL[2:0]	PWM Data Source
0x0	12-bit Angle Data
0x2	12-bit Velocity Data (±120,000 RPM Range)
Others	Factory Test Data

7.6 SPI Interface

The MT6828 also provides a 4-Wire SPI interface for a host MCU both to read back digital absolute angle information from its internal registers and to programmed its EEPROM.

7.6.1 SPI Reference Circuit

The reference circuit for SPI interface of a single chip please refer to Figure 5 & Figure 6. The multi-chip application is shown in Figure-14.

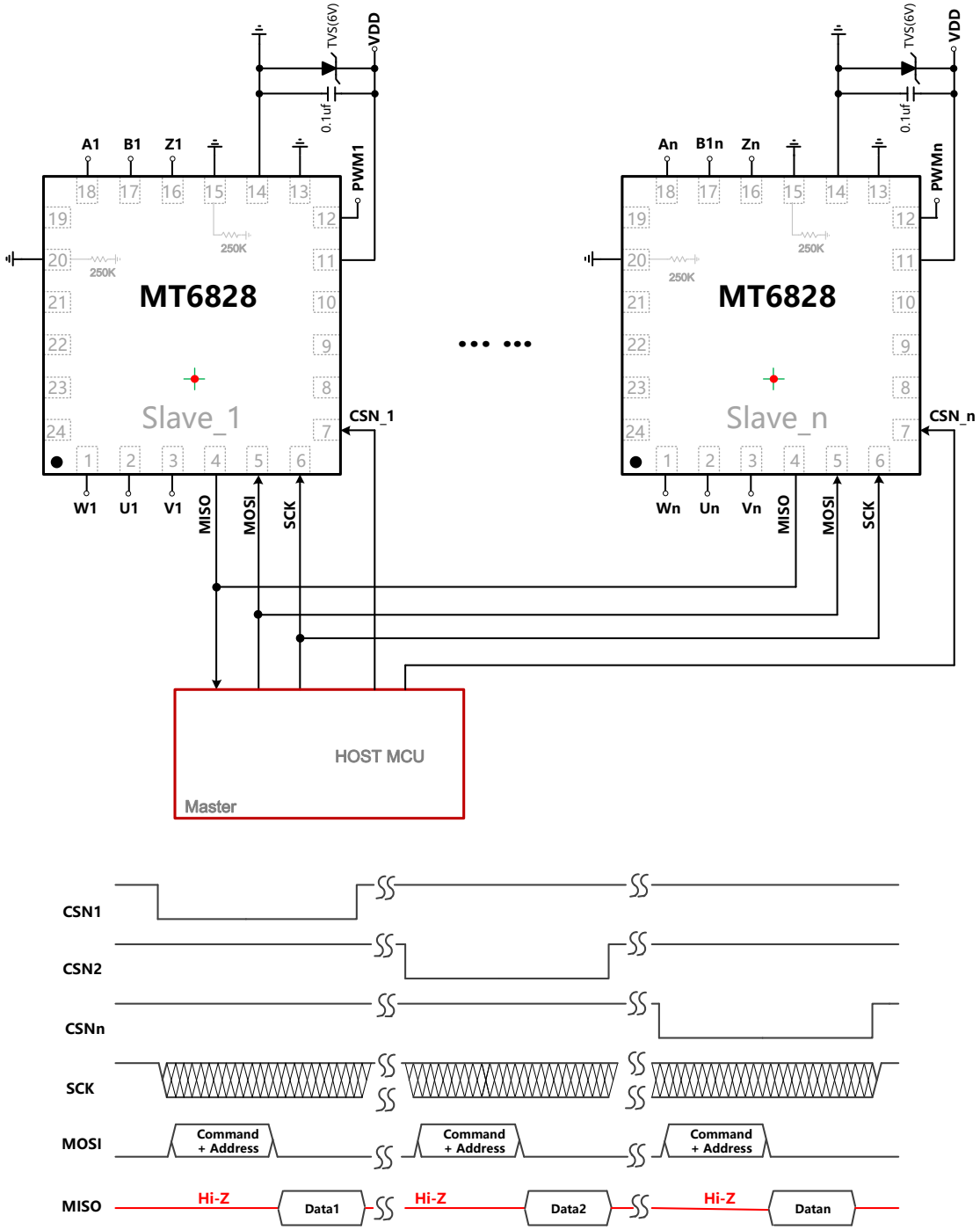


Figure-14: 4-Wire SPI Reference Circuit with multi-chips

7.6.2 SPI Timing Diagram

The MT6828 SPI uses mode=3 (CPOL=1, CPHA=1) to exchange data. As shown in Figure-15, a data transfer starts with the falling edge of CSN. The MT6828 samples data on the rising edge of SCK, and the data transfer finally stops with the rising edge of CSN.

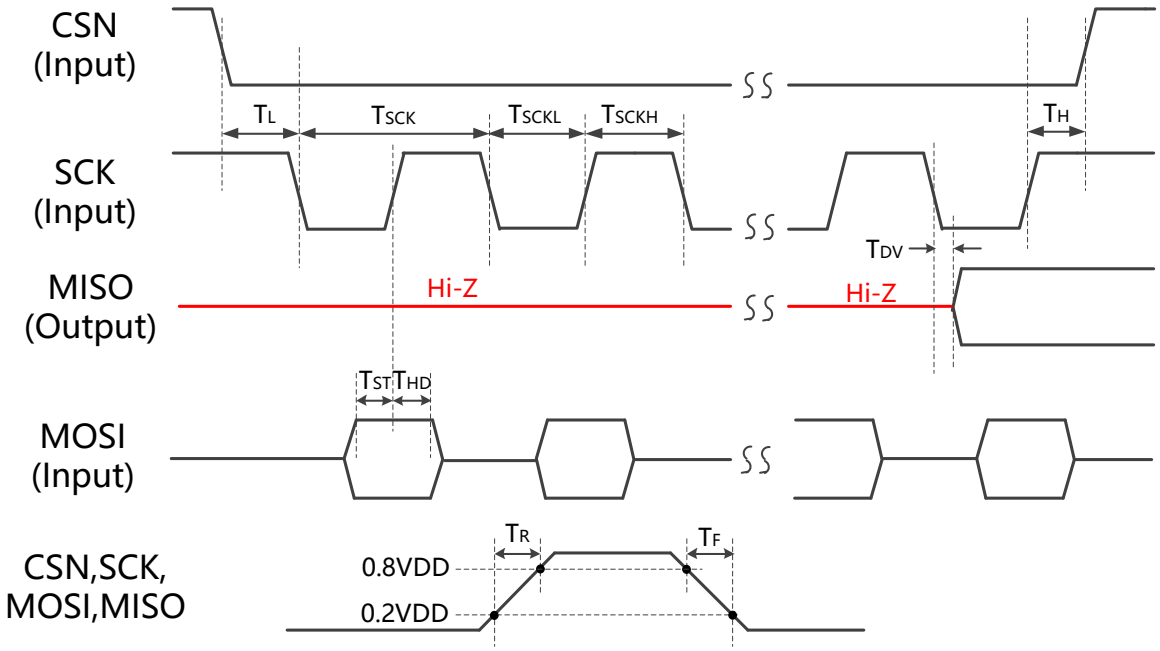


Figure-15: SPI Timing Diagram

SPI Timing Parameter

Symbol	Notes	Min.	Typ.	Max.	Unit
T_L	Time between CSN falling edge and SCK falling edge	100		-	ns
T_{SCK}	Clock period	64		-	ns
T_{SCKL}	Low period of clock	30		-	ns
T_{SCKH}	High period of clock	30		-	ns
T_H	Time between SCK last rising edge and CSN rising edge	0.5•TSCK		-	ns
T_R	Rise Time of Digital Signal (with 20pf Loading Condition)	-	10	-	ns
T_F	Fall Time of Digital Signal (with 20pf Loading Condition)	-	10	-	ns
T_{DV}	Data valid time of MISO (with 20pf Loading Condition)	-	-	15	ns
T_{ST}	Setup time of MOSI data	10	-	-	ns
T_{HD}	Hold time of MOSI data	10	-	-	ns

7.6.3 SPI Protocol

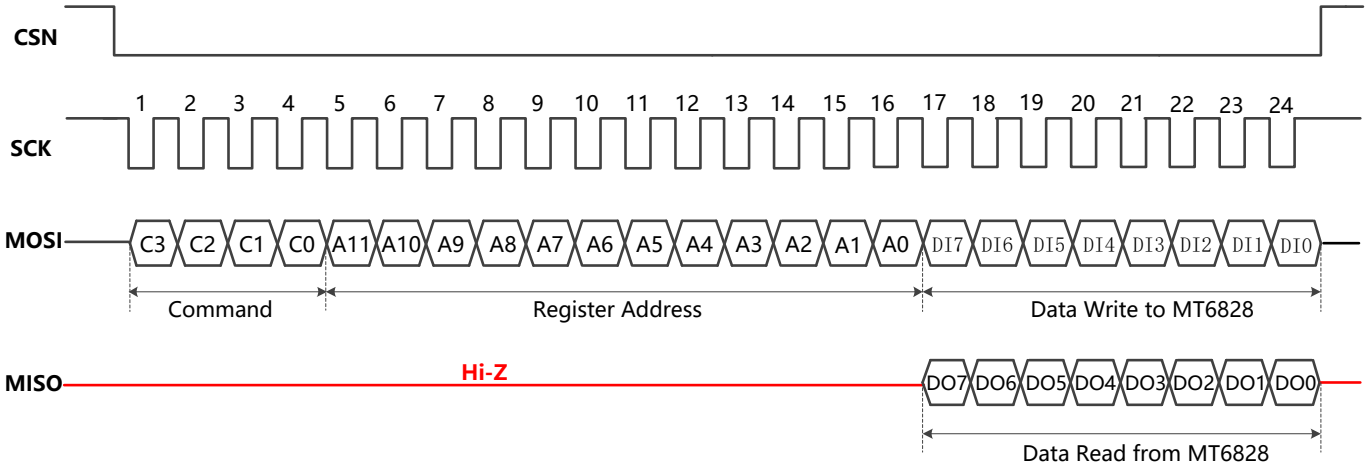


Figure-16: 4-Wire SPI Timing

An SPI data transfer starts with the falling edge of CSN and stops at the rising edge of CSN. SCK is the Serial Port Clock, and it is controlled by the SPI master, it is high when there is no SPI transmission. MOSI (master output slave input) and MISO (master input slave output) is the Serial Port Data Input and Output, it is driven at the falling edge of SCK and should be captured at the rising edge of SCK. The 'MISO' keeps Hi-Z unless it drives data as shown in Figure-16.

Bit 1-4: Operation Command bits C3~C0.

C3~C0	Operation	Notes
0011	Read	User Read Registers
0110	Write	User Write Registers
1100	Programming EEPROM	User Erase and Program EEPROM
0101	Quick Programming Zero-Position	Quick Program Current Position as Zero Position to EEPROM
1010	Burst Angle Read	Read Angle Registers Repeatedly
Others	N/A	-

Bit 5-16: Address A11~A0. This is the address field of the indexed register.

Bit 17-24: Data DI7~DI0 (Write Operation). This is the data that will be written into the device.

Bit 17-24: Data DO7~DO0 (Read Operation). This is the data that will be read from the device.

7.6.4 SPI Read One Byte Register

For single byte read, the operation command C3~C0= '0011'. The target 12-bit register address A11~A0 please refer to Chapter 10.

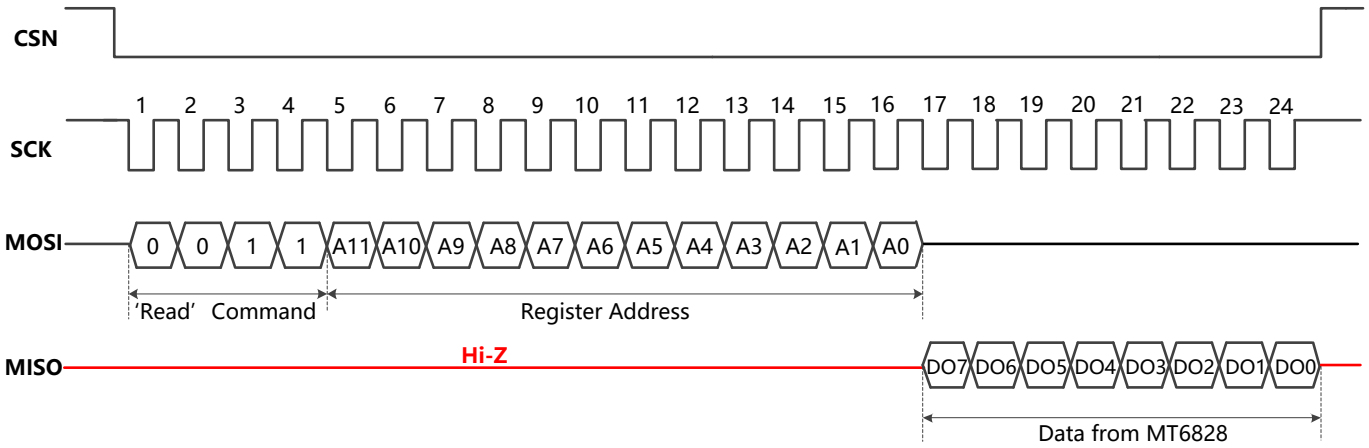


Figure-17: SPI Read One Byte Register

7.6.5 SPI Write One Byte Register

For single byte write, the operation command C3~C0= '0110'. The target 12-bit register address A11~A0 please refer to Chapter 10.

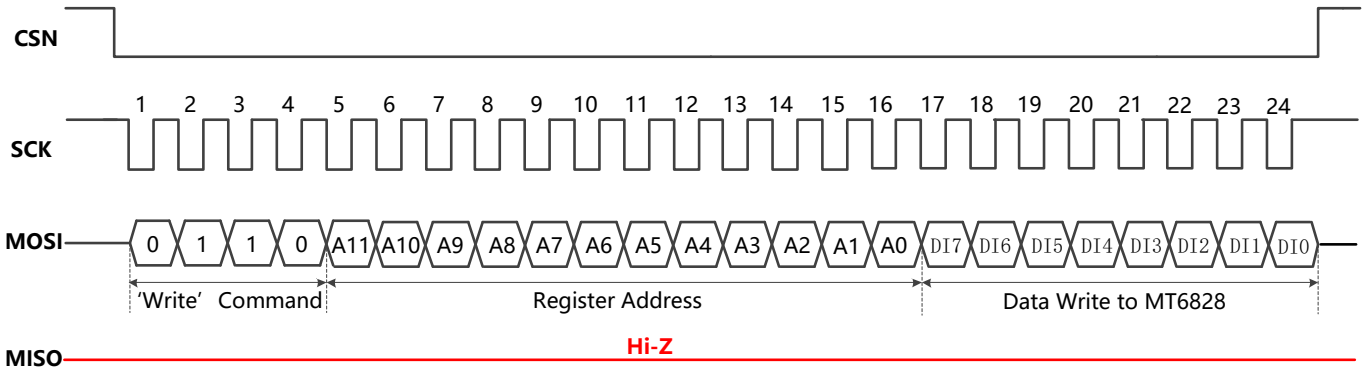


Figure-18: SPI Write One Byte Register

7.6.6 SPI Programming EEPROM

For EEPROM programming, the operation command C3~C0= '1100' , and all the data in 'Register Map' will be programmed to EEPROM. When the command received successfully, the acknowledge bits ack7~ack0 will return value 0x55; any other value indicates the command received failed.

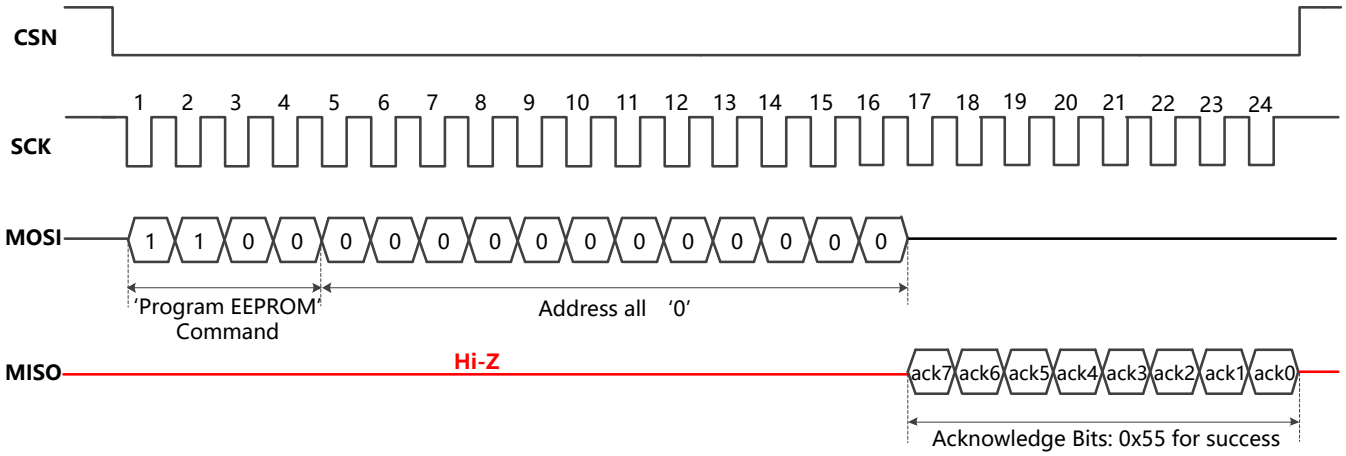


Figure-19: SPI Programming EEPROM

When the data is programmed to EEPROM, they will be non-volatile; while the data in register map it is volatile, meaning it is lost when the power goes off. The user could read/write the register map through SPI interface and program the data of register map into EEPROM by SPI command.

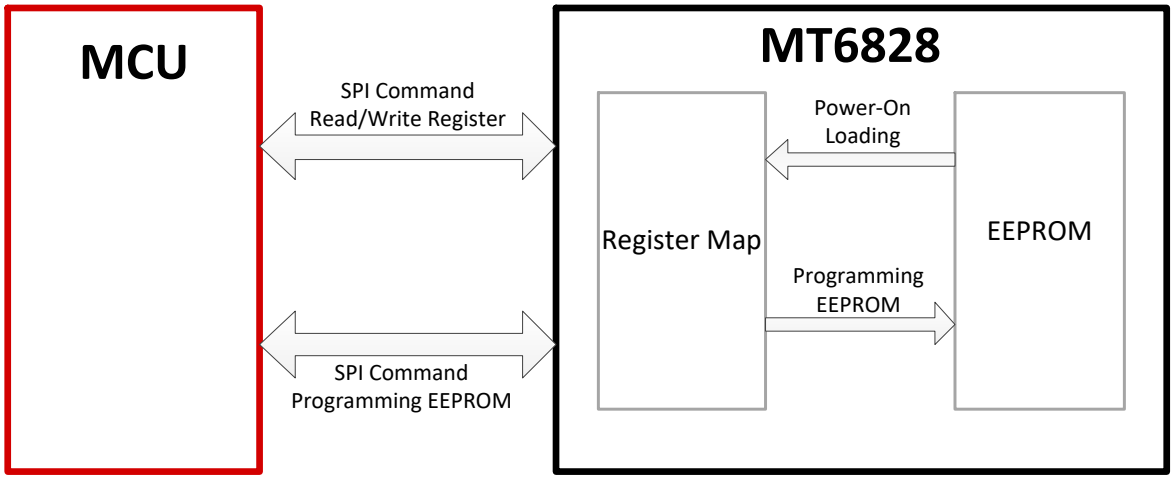


Figure-20: Register Map and EEPROM

7.6.7 SPI Auto Setting Zero-Position

MT6828 provide an Auto Setting Zero Position command, which will automatically write current position as the new Zero Position to the register 'ZERO_POS[11:0]'. The operation command is C3~C0= '0101', when the command is received successfully, the acknowledge bits ack7~ack0 will return value 0x55; any other value indicates the command received failed.

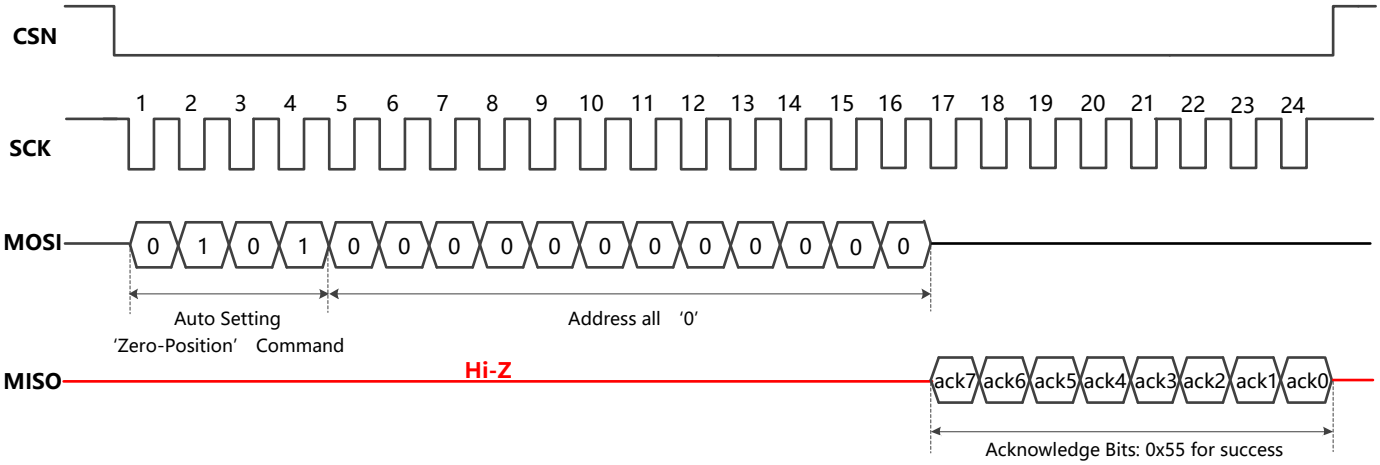


Figure-21: SPI Auto Setting Zero-Position Register

This command only stores the current position into 'ZERO_POS[11:0]' register. If the user want to program it to EEPROM, an SPI program EEPROM operation should be additionally done as shown in Figure 19.

7.6.8 SPI Single Byte Read Angle

The 21-bit absolute angle data could be read by SPI interface as shown in Figure 22. In order to facilitate the user to synchronize the sampling of angle data, when CSN is pulled down, MT6828 internally latched the data of 0x003~0x006, which will not be refreshed until all 0x003~0x006 registers have been read out, or another falling edge of CSN is received.

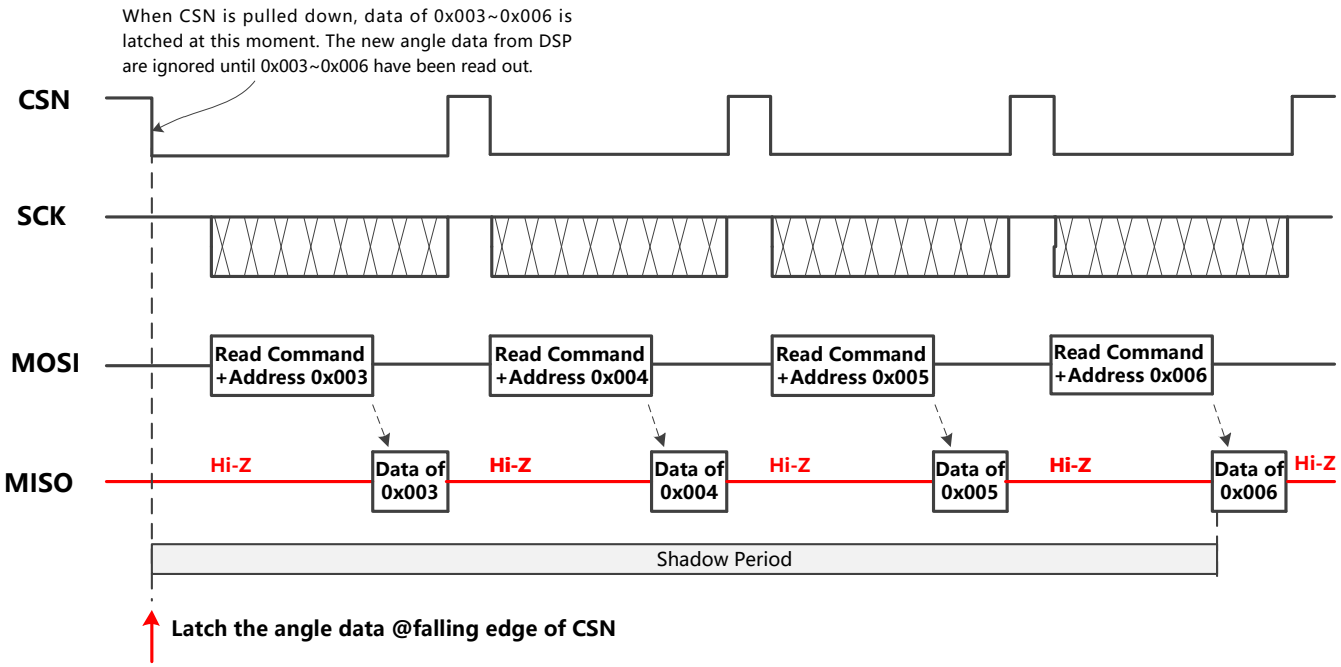


Figure-22: SPI Single Byte Read Angle Register

Angle Data Register (Read Only)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x003	ANGLE[16:9]							
0x004	ANGLE[8:1]							
0x005	ANGLE[0]	0	0	0	0	STATUS[2:0]		
0x006	CRC[7:0]							

0~360° absolute angle θ could be calculated by the below formula with ANGLE[16:0]:

$$\theta = \frac{\sum_{i=0}^{16} D<i> \bullet 2^{i}}{2^{17}} \bullet 360°$$

STATUS Register (Read Only)

STATUS[2:0]	Notes
Bit [0]	Rotation Over Speed Warning; Default '0', Logic '1' for Warning;
Bit [1]	Weak Magnetic Field Warning; Default '0', Logic '1' for Warning;
Bit [2]	Under Voltage Warning; Default '0', Logic '1' for Warning;

CRC Data Range: ANGLE[16:0], 4 bits '0' and STATUS[2:0] total 24bits

CRC polynomials: X^8+X^2+X+1, MSB (ANGLE[16]) shifts in first.

7.6.9 SPI Burst Read Angle

The MT6828 provides an SPI burst read angle registers mode for faster data transfer than single byte read mode as shown in Figure 23. The operation command of this mode is C3~C0= '1010' , after MCU sends this command with address 0x003, MT6828 continuously outputs angle data of register 0x003~0x006.

In order to facilitate the user to synchronize the sampling of angle data, when CSN is pulled down, MT6828 internally latched the data of 0x003~0x006, which will not be refreshed until all 0x003~0x006 registers have been read out, or another falling edge of CSN is received.

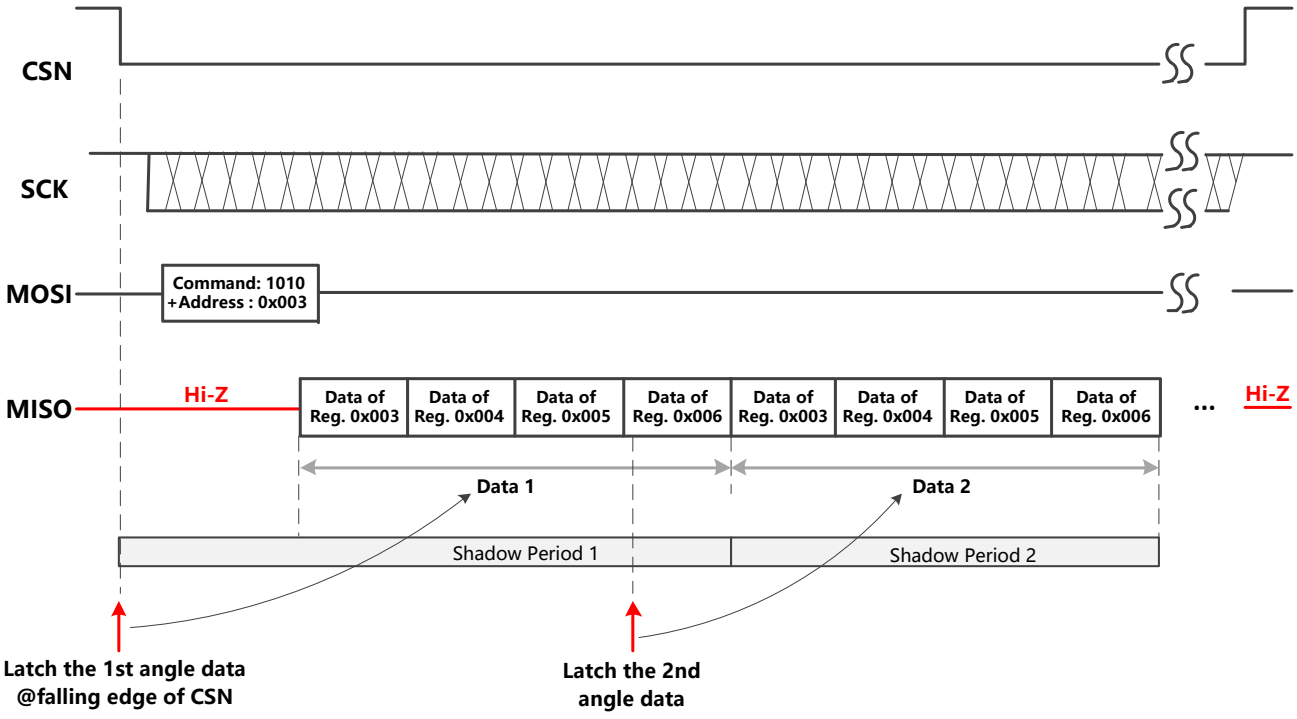


Figure-23: SPI Burst Read Angle Registers

8. Change & Program Zero-Position to EEPROM

'ZERO_POS[11:0]' register defines the zero degree of MT6828, the default zero degree of MT6828 with a two-pole magnet is shown in Chapter 12. There are two methods to change the register 'ZERO_POS[11:0]' as shown in Figure-24.

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x009	ZERO_POS[11:4]								EEPROM
0x00A	ZERO_POS[3:0]				MagnTek Use Only		Z_PUL_WID[1:0]		EEPROM

(1) Auto Change by SPI with '*Auto Setting Zero-Position*' Command

This method can only change the zero-position to current mechanical position.

(2) Manual Calculate Zero Degree and Write Register by SPI

(a) Write data 0x000 to register 'ZERO_POS[11:0]' by SPI;

(b) Read out the angle data of current position by SPI;

(c) Calculate the target Zero-Position value, write it to 'ZERO_POS[11:0]' by SPI;

For both auto and manual methods, an extra SPI '***Program EEPROM***' operation is necessary for storing the new zero-position value into EEPROM, and at least to wait 6 seconds for the EEPROM programming without any other operation.

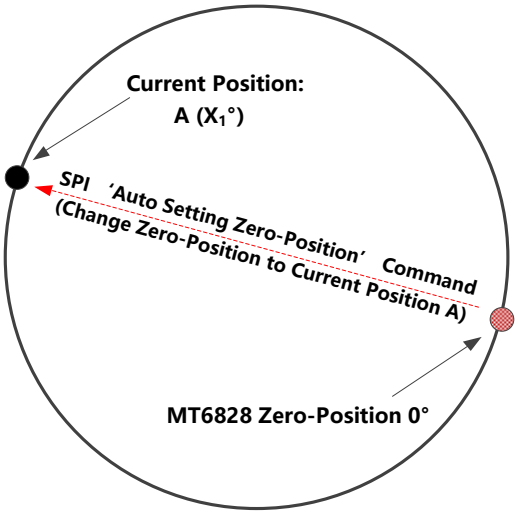


Figure-24(1) Auto Change

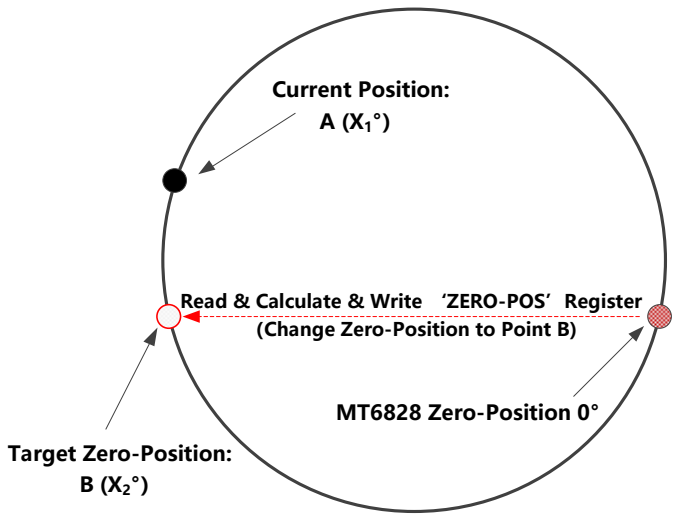


Figure-24(2) Manual Change

9. Register Map

For both auto and manual methods, an extra SPI '***Program EEPROM***' operation is necessary for storing the new zero-position value into EEPROM, and at least to wait 6 seconds for the EEPROM programming without any other operation.

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x001	USER_ID[7:0]								EEPROM
0x002	**Not Used**								NA
0x003	ANGLE[16:9]								Read Only
0x004	ANGLE[8:1]								Read Only
0x005	ANGLE[0]	0	0	0	0	STATUS[2:0]			Read Only
0x006	CRC[7:0]								Read Only
0x007	ABZ_RES[11:4]								EEPROM
0x008	ABZ_RES[3:0]				**MagnTek Use Only**		ABZ_OFF	AB_SWAP	EEPROM
0x009	ZERO_POS[11:4]								EEPROM
0x00A	ZERO_POS[3:0]				**MagnTek Use Only**		Z_PUL_WID[2:0]		EEPROM
0x00B	**MagnTek Use Only**		UVW_MUX	UVW_OFF	UVW_RES[3:0]				EEPROM
0x00C	**MagnTek Use Only**			PWM_FQ	PWM_POL	PWM_SEL[2:0]			EEPROM
0x00D	**MagnTek Use Only**				ROT_DIR	HYST[2:0]			EEPROM

Warning: Do Not Change the 'MagnTek Use Only' Bits

(1) 0x001 *User_ID (EEPROM)*

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x001	USER_ID[7:0]								EEPROM

- 'USER_ID[7:0]' is a free byte for the user.

(2) 0x003~ 0x006 Angle Data Register (Read Only)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x003	ANGLE[16:9]								Read Only
0x004	ANGLE[8:1]								Read Only
0x005	ANGLE[0]	0	0	0	0	STATUS[2:0]			Read Only
0x006	CRC[7:0]								Read Only

- These read only bytes are angle data registers, the detail description please refer to Page-24 Chapter 7.6.8.

(3) 0x007~ 0x008 ABZ Resolution and Related Registers (EEPROM)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x007	ABZ_RES[11:4]								EEPROM
0x008	ABZ_RES[3:0]				MagnTek Use Only		ABZ_OFF	AB_SWAP	EEPROM

- 'ABZ_RES[11:0]' configures the resolution of AB output, please refer to Chapter 7.3;

Reg. ABZ_RES[11:0]	AB Resolution (Pulse per. Round)	Factory Default Setting
0x000	1	√
0x001	2	
… …	… …	
0x3FF	1,024	
0x400 ~0xFFF	1,024	

- 'ABZ_OFF' configures the on/off state of ABZ output;

Reg. ABZ_OFF	ABZ Output	Factory Default Setting
0x0	ON	√
0x1	OFF	

- 'AB_SWAP' configures the swapping of incremental output A and B;

Reg. AB_SWAP	AB Output	Factory Default Setting
0x0	No Swap	√
0x1	Swap	

(4) 0x009~ 0x00A Z Pulse Related Registers (EEPROM)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x009	ZERO_POS[11:4]								EEPROM
0x00A	ZERO_POS[3:0]				Z_EDGE	Z_PUL_WID[2:0]			EEPROM

- 'ZERO_POS[11:0]' configures the Zero-Position of MT6835, it is effective for all outputs;

Reg. ZERO_POS[11:0]	Absolute Position (°)	Factory Default Setting
0x000	0	√
0x001	0.088	
… …	… …	
0xFFE	359.824	
0xFFF	359.912	

- 'Z_EDGE' configures the relationship of Z pulse edge and zero degree;

Reg. Z_EDGE	Z Pulse Edge with 0°	Factory Default Setting
0x0	Rising Edge Aligned to 0°	√
0x1	Falling Edge Aligned to 0°	

- 'Z_PUL_WID[2:0]' configures the width of Z pulse.

Reg. Z_PUL_WID[2:0]	Width (LSBs/°)	Factory Default Setting
0x0	1	√
0x1	2	
0x2	4	
0x3	8	
0x4	16	
0x5	60°	
0x6	120°	
0x7	180°	

(5) 0x00B Z_PHASE and UVW Related Registers (EEPROM)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x00B	Z_PHASE[1:0]		UVW_MUX	UVW_OFF	UVW_RES[3:0]				EEPROM

- 'Z_PHASE[1:0]' configures the phase between Z and A/B output, please refer to Figure 12 on Page-15;

- 'UVW_MUX' configures UVW pins (Pin.1~Pin.3) output UVW or –A-B-Z ;

Reg. UVW_MUX	UVW Output Pin	Factory Default Setting
0x0	UVW	√
0x1	-A-B-Z	

- 'UVW_OFF' configures the on/off state of the UVW output;

Reg. UVW_OFF	UVW Output	Factory Default Setting
0x0	ON	√
0x1	OFF	

- 'UVW_RES[3:0]' configures the resolution of UVW output;

Reg. UVW_RES[3:0]	UVW Pole Pairs	Factory Default Setting
0x0	1	√
0x1	2	
… …	… …	
0xE	15	
0xF	16	

(6) 0x00C PWM and NLC Calibration Related Registers (EEPROM)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x00C	MagnTek Use Only			PWM_FQ	PWM_POL	PWM_SEL[2:0]			EEPROM

- 'PWM_FQ' configures the PWM frame frequency ;

Reg. PWM_FQ	PWM Frame Frequency	Factory Default Setting
0x0	994 Hz	√
0x1	497 Hz	

- 'PWM_POL' configures PWM effective voltage level;

Reg. PWM_POL	PWM Polarity	Factory Default Setting
0x0	High Voltage Effective	√
0x1	Low Voltage Effective	

- 'PWM_SEL[2:0]' configures the PWM output source;

Reg. PWM_SEL[2:0]	PWM Data Source	Factory Default Setting
0x0	12-bit Angle Data	√
0x2	12-bit Velocity Data	
Others	Factory Test Data	

(7) 0x00D (EEPROM)

Address	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Type
0x00D	**MagnTek Use Only**				ROT_DIR	HYST[2:0]			EEPROM

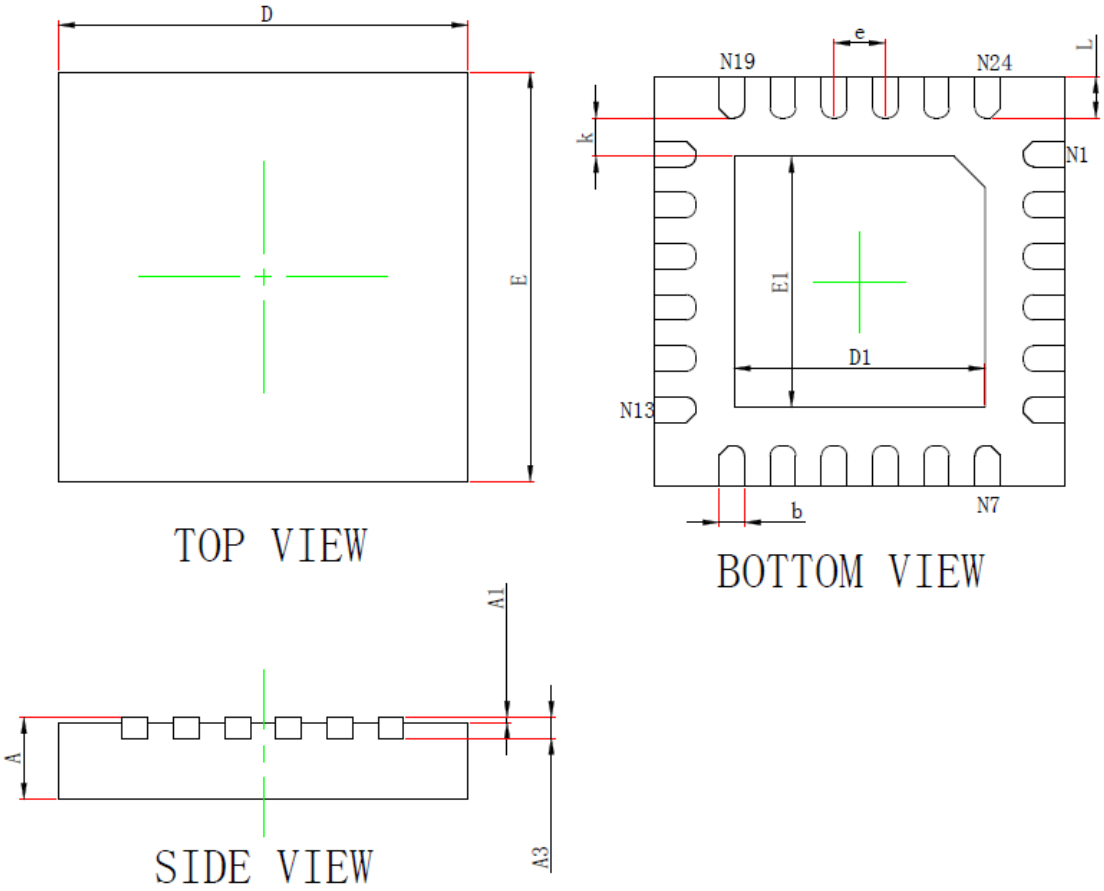
- 'ROT_DIR' configures the rotation direction (logic 0 for CCW), please refer to Figure 7;

Reg. ROT_DIR	Rotation Direction	Factory Default Setting
0x0	Counter-Clockwise	√
0x1	Clockwise	

- 'HYST[2:0]' configures the hysteresis window for angle output

Reg. HYST[2:0]	Hysteresis Window	Factory Default Setting
0x0	0.022°	√
0x1	0.044°	
0x2	0.088°	
0x3	0.176°	
0x4	0	
0x5	0.003°	
0x6	0.006°	
0x7	0.011°	

10. Package Information



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	3.950	4.050	0.156	0.159
E	3.950	4.050	0.156	0.159
E1	2.400	2.500	0.094	0.098
D1	2.400	2.500	0.094	0.098
k	0.200MIN		0.008MIN	
b	0.200	0.300	0.008	0.012
e	0.500TYP.		0.020TYP.	
L	0.350	0.450	0.014	0.018

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12. Revision History

Revision Number	Date	Comments
0.5	2021.02	Initial Release as Draft
1.0	2022.01	Mass Production Release