MTS100

Wheel Speed Sensor with Excellent Jitter

1 Product Description

The MTS100 is produced with SIP (System in Package) technology, which integrates AMR sensor, ASIC and capacitor in one IC body.

The MTS100 is a wheel speed sensor with direction indication designed for sophisticated vehicle control systems. The best-in-class jitter performance makes it the best choice for wheel speed applications.

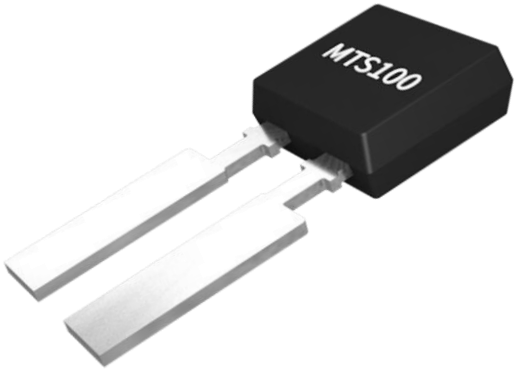
The MTS100 based on AMR technology, excellent sensitivity & stability for wheel speed applications, can meet harsh automotive requirements.

The MTS100 supports standard protocol & PWM protocol & AK protocol.

The MTS100 is developed based on ISO 26262.

2 Features

- Developed Based on ISO 26262
- AMR Based
- SIP (System in Package) Technology
- Wide Operating Temperature -40℃ to 150℃
- Excellent Jitter Performance
- High Sensitivity Enables Outstanding Airgap
- Support Standard & PWM & AK protocol
- RoHS Compliant: (EU)2015/863



AEC Qualified

By MagnTek AMR

3 Product Overview of MTS100

Part No.	Description
MTS100A-STD	IMA-2L, tape & reel (3000pcs/bag)
MTS100A-PWM	IMA-2L, tape & reel (3000pcs/bag)
MTS100A-AK	IMA-2L, tape & reel (3000pcs/bag)

4 Applications

- Wheel Speed Sensor
- ABS Sensor

5. Pin Configuration and Functions

No.	Name	Description
1	Vcc	Supply voltage
2	GND	Ground

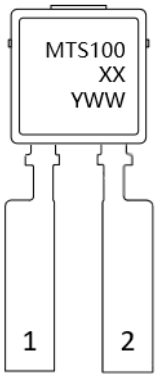


Figure.1 Pin Configuration & Functions

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History

1.0 Version	Original Version

6 Functional Block Diagram

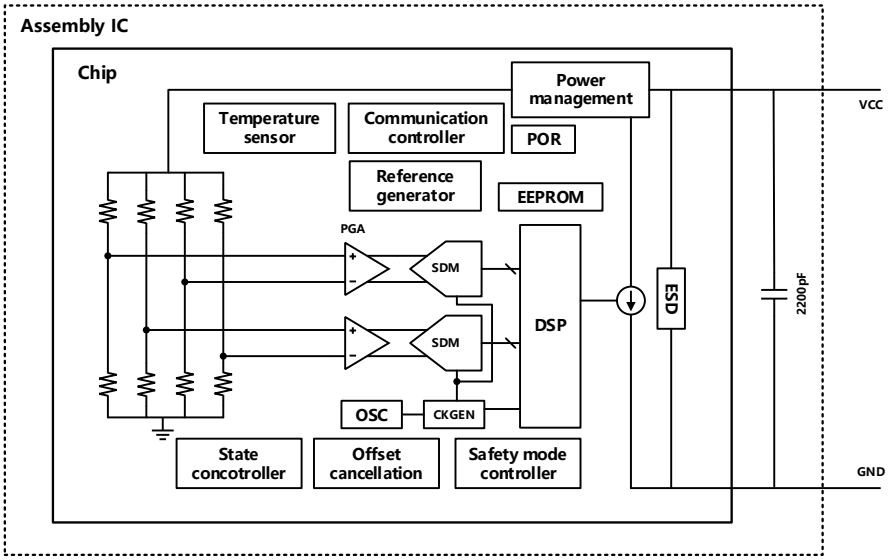


Figure.2 Functional Block Diagram

7 Electrical and Magnetic Characteristics

7.1 Absolute Maximum Ratings

Absolute maximum ratings are limited values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability
All voltages listed are referenced to GND.

Symbol	Parameters		Min	Max	Unit
V_{CC}	Supply Voltage		-0.3	22	V
I_R	Reverse Current		-200	-	mA
T_A	Operating Ambient Temperature		-40	150	℃
T_J	Junction Temperature (1)	12500h	-40	110	℃
		or 10000h	-40	125	℃
		or 5000h	-40	150	℃
		or 2500h	-40	160	℃
		or 500h	-40	170	℃
T_S	Storage Temperature		-40	150	℃

(1) The life time statement is based on the MagnTek qualification results. The actual life time of each component depends on its application. The life time statement shall in no event extend the agreed warranty period

7.2 ESD Ratings

Symbol		Reference	Values	Unit
V_{ESD}	Human-body model (HBM)	AEC-Q100-002	20000	V
	Charged-device model (CDM)	AEC-Q100-011	1000	V

7.3 Electrical Specifications

At T_A=-40~150 ℃, Vcc=5.4V~18V (unless otherwise specified)

Symbol	Parameters	Test Condition	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	Standard & PWM & AK Protocol Referred to GND; Directly on IC leads; Not include the voltage drop at R_L	5.4	-	18	V
I_{Error}	Error Supply Current		3.5	3.8	4.2	mA
R_L	Load Resistance	AK Protocol	15	-	50	Ω
		Standard & PWM Protocol	15	-	75	Ω
I_{CCL}	Low Level Supply Current		6.8	7.2	7.8	mA
I_{CCM}	MID Level Supply Current	AK Protocol	12.6	14.2	15.6	mA
I_{CCH}	High Level Supply Current	AK Protocol	23.2	26.8	30.4	mA
		Standard & PWM Protocol	12.6	14.2	15.6	mA
I_{CCH}/I_{CCL}	High Level vs. Low Level	AK Protocol	3.3	3.7	4.1	-
		Standard & PWM Protocol	1.8	1.95	2.1	-
I_{CCM}/I_{CCL}	MID Level vs. Low Level	AK Protocol	1.8	1.95	2.1	-
I_{Start}	Start up Current		-	7.2	-	mA
T_r	Rise Time	Output Slew Rate; I_{CCL} to I_{CCH} (10% to 90%)	8	-	27	mA/us
T_f	Fall Time	Output Slew Rate; I_{CCH} to I_{CCL} (90% to 10%)	8	-	27	mA/us
V_{AC}	Supply Voltage Modulation	10Hz < F_{MOD} <150kHz	-	-	6	Vpp
f_{Mag}	Magnetic Signal Frequency		0	-	3	KHz
D.C.	Duty Cycle		40	-	60	%
T_{PO}	Power on Time		-	-	1	mS
V_{Reset}	Reset Voltage	Directly on IC Leads	-	-	4.0	V
V_{Rel}	Release Voltage	Directly on IC Leads	-	-	5.4	V
V_{Hys}	Hysteresis Voltage	Directly on IC Leads	-	1.4	-	V
S_{Jitter}	Period Jitter	1 Sigma Magnetic Signal @30Gs	-	0.1	-	%
N_{Spd}	Number of Speed Pulses	After T_{PO} to 1st Speed Pulse	-	-	4	1

7.4 Magnetic Characteristics

The typical values based on Vcc=12V & T_A =25℃

Symbol	Parameters	Min	Typ	Max	Unit
dB_{Limit}	Minimum Differential Magnetic Input Signal	-	2	-	Gs
$dB_{Warning}$	Warning Differential Magnetic Input Signal	-	5	-	Gs
dB_{EL}	EL Differential Magnetic Input Signal	-	10	-	Gs

7.5 Switching Behavior

The output switching occurs at the zero crossing during the rising edge of the differential magnetic signal, the speed pulse will follow the signal of channel A, after compared with the signal of channel B, the direction can be detected

The output has been designed as a two wire current interface based on a standard & PWM & AK principle. Each zero crossing during the rising edge of the magnetic input signal triggers an output pulse indicated by high level & low level current consumption

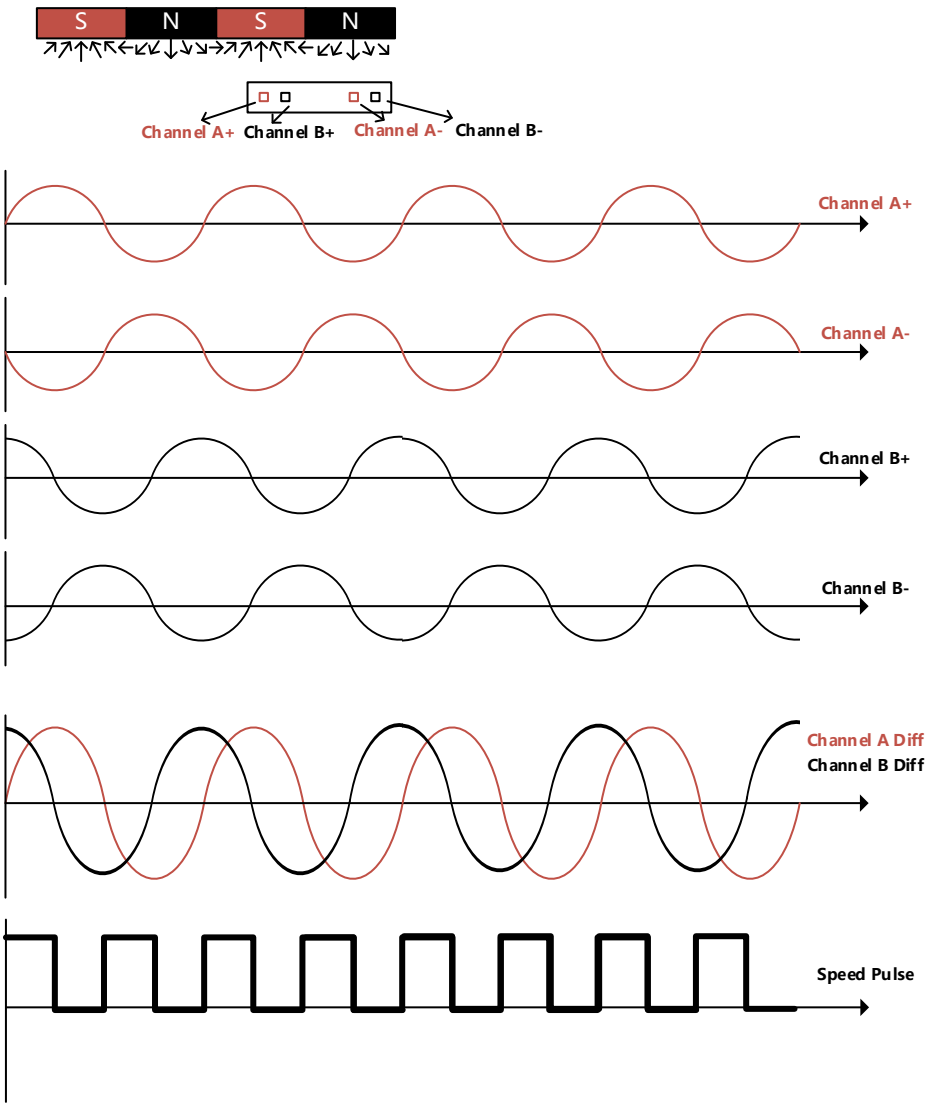


Figure.3 Magnetic Input Signal and Corresponding Output Switching (Standard Protocol as Example)

7.6 Typical Output Waveform (Standard Protocol)

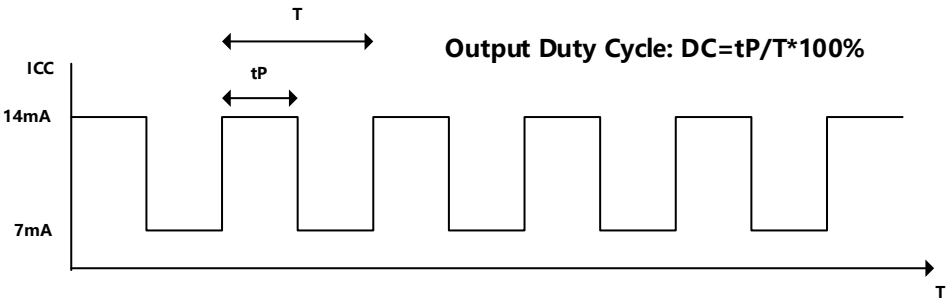


Figure.4 Standard Protocol

7.7 Typical Output Waveform (PWM Protocol)

The PWM protocol provides the information about rotational direction and air gap

The typical values based on Vcc=12V & T_A =25℃

Symbol	Parameters	Condition	Min	Typ	Max	Unit
$T_{pre-low}$	Length of Pre-low Pulse		38	45	52	us
$T_{Warning}$	Length of Warning Pulse	dB<dB$_{Warning}$	38	45	52	us
T_{DR-L}	Length of DR-L Pulse		76	90	104	us
T_{DR-R}	Length of DR-R Pulse		153	180	207	us
$T_{DR-L\&EL}$	Length of DR-L & EL Pulse		306	360	414	us
$T_{DR-R\&EL}$	Length of DR-R & EL Pulse		616	720	828	us
f_{ELMAX}	Output of EL Pulse, maximum frequency		-	117	-	Hz
tStop	Length of Stand Still Pulse		1.23	1.44	1.65	ms
PWM TStop	Period of Stand Still		590	737	848	ms

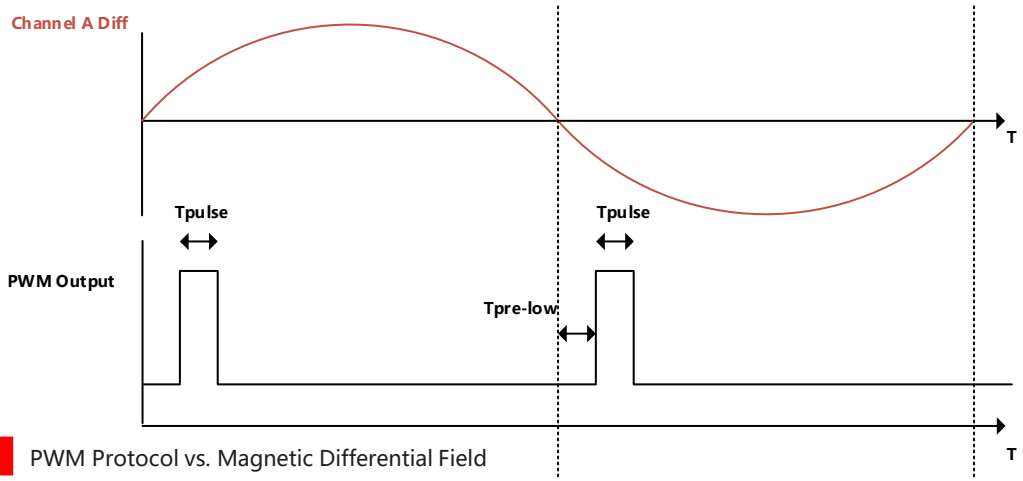


Figure.5 PWM Protocol vs. Magnetic Differential Field

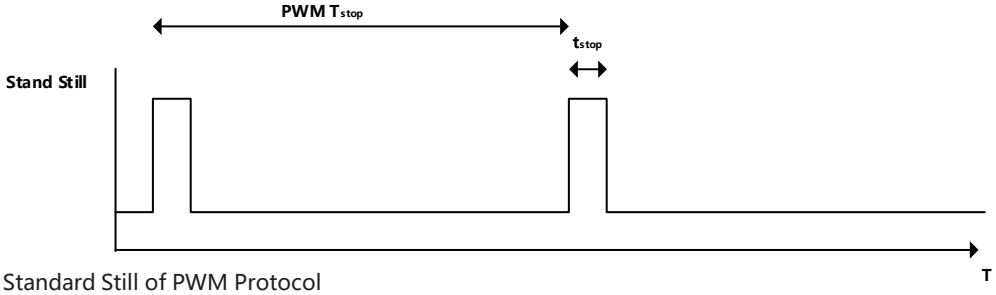


Figure.6 Standard Still of PWM Protocol

7.7 Typical Output Waveform (PWM Protocol) (Continued)

EL pulse range:

If the magnetic differential field exceeds dB_{EL}, the output pulse lengths are 90us or 180us respectively, depending on the direction of rotation. When the magnitude of the magnetic differential field is below dB_{EL} and above $dB_{Warning}$, the output pulse lengths are 360us or 720us respectively, depending on the direction of rotation. The device works with full functionality.

Warning pulse range:

Warning pulse information is issued in the output pulse length when the magnetic field is below than $dB_{Warning}$ and above dB_{Limit}.

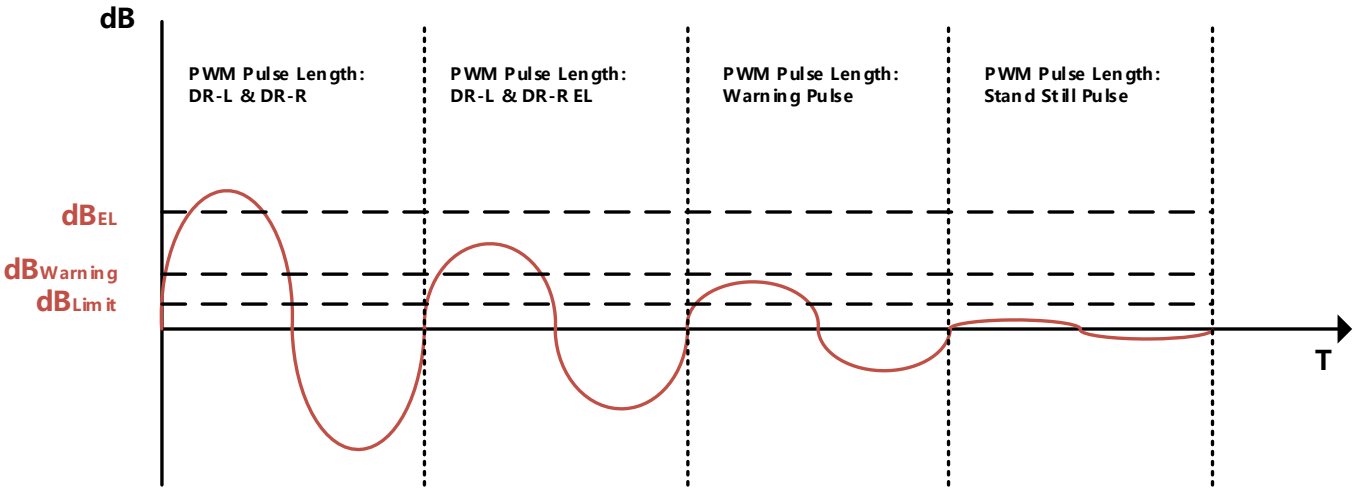


Figure.7 Description of PWM Protocol with Magnetic Differential Field

7.8 Typical Output Waveform (AK Protocol)

A wheel speed pulse is generated whenever a zero crossing during the rising edge of the sensor signal is detected. The pulse duration is tp. Before and after a speed pulse, there is always an initial or pre-bit send which length is tp/2 at a level of I_{CCL}. After the pre-bit, the data bits 8 to 0 are sent.

Bit (db)	Definition	Name	Remark
0	Error Bit or Airgap Reserve	ERR or LR	1=Error
1	Validity of Signal Amplitude Measurement	SLM	0=LM0 & LM1 & LM2 valid 1=LM0 & LM1 & LM2 invalid
2	Not Assigned		Default=0
3	Direction Validity	GDR	0=Invalid 1=Valid
4	Direction Information	DR	0=Positive Rotation 1=Negative Rotation
5	Airgap Gauge	LM0	
6		LM1	
7		LM2	
Parity	Even Parity	P	Calculated

7.8 Typical Output Waveform (AK Protocol) (Continued)

Time parameters of AK Protocol

The typical values based on Vcc=12V & T_A =25℃

Symbol	Parameters	Condition	Min	Typ	Max	Unit
tp	Pulse Time	Speed Pulse	42.5	50	57.5	us
		Data Bits	42.5	50	57.5	us
AK T_{Stop}	Stop period	Stand Still Period	130	150	170	ms

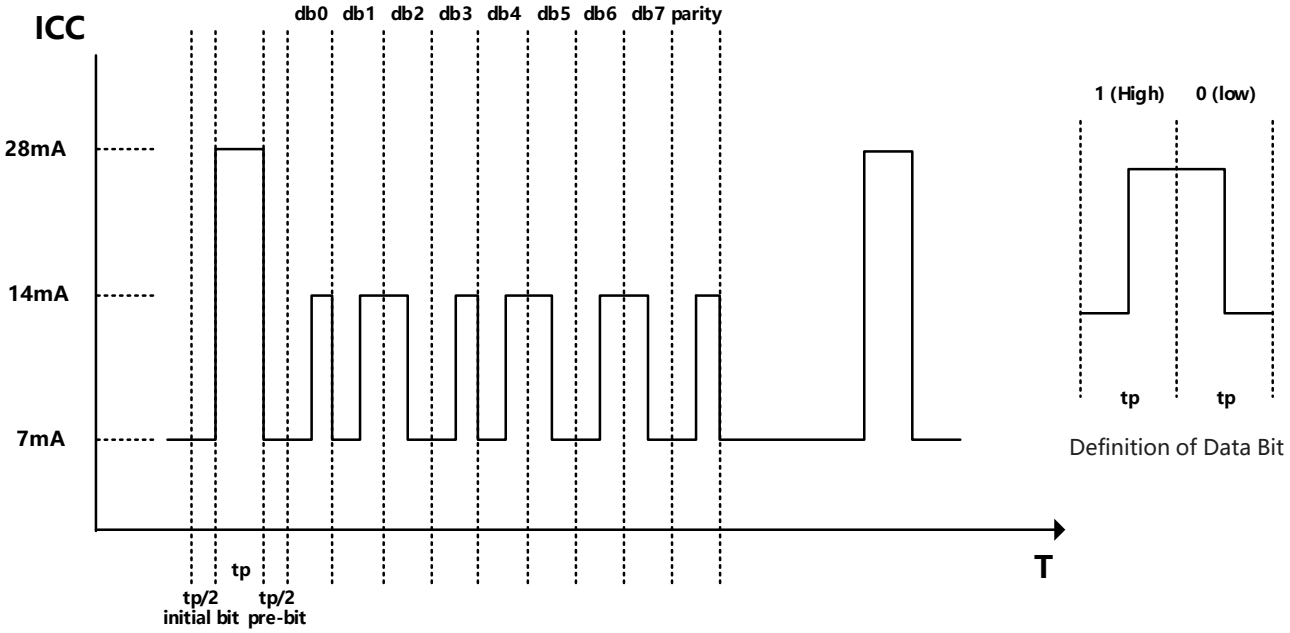


Figure.8 AK Protocol

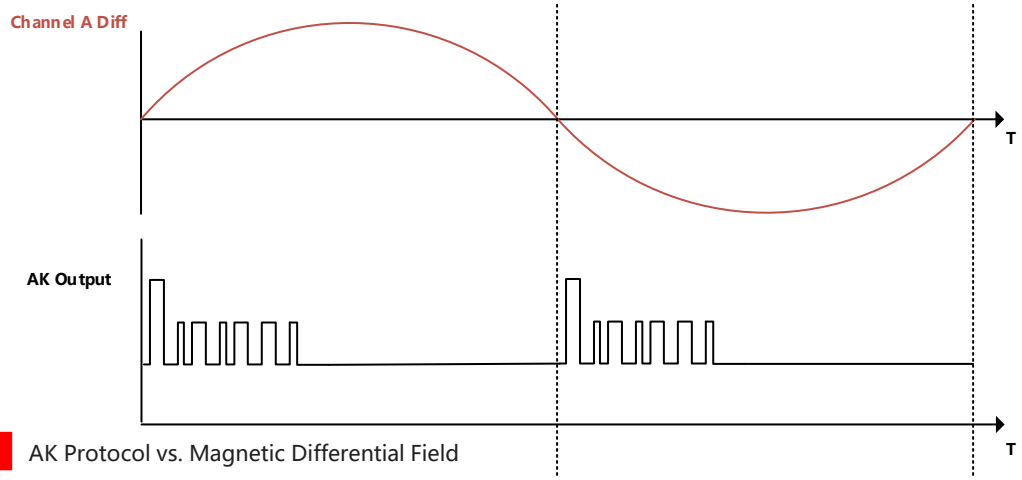


Figure.9 AK Protocol vs. Magnetic Differential Field

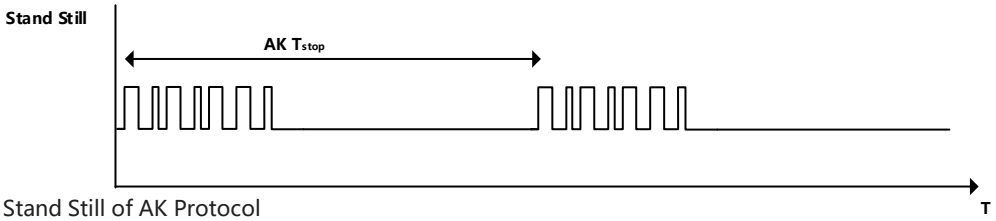


Figure.10 Stand Still of AK Protocol

7.9 Undervoltage Behavior

If the V_{CC} drops below the reset level V_{Reset} the sensor reduces its current consumption to I_{ERROR} regardless of the magnetic encoder input signal. After V_{CC} exceeding again the voltage release level V_{Rel} the sensor restarts and resumes in normal operation.

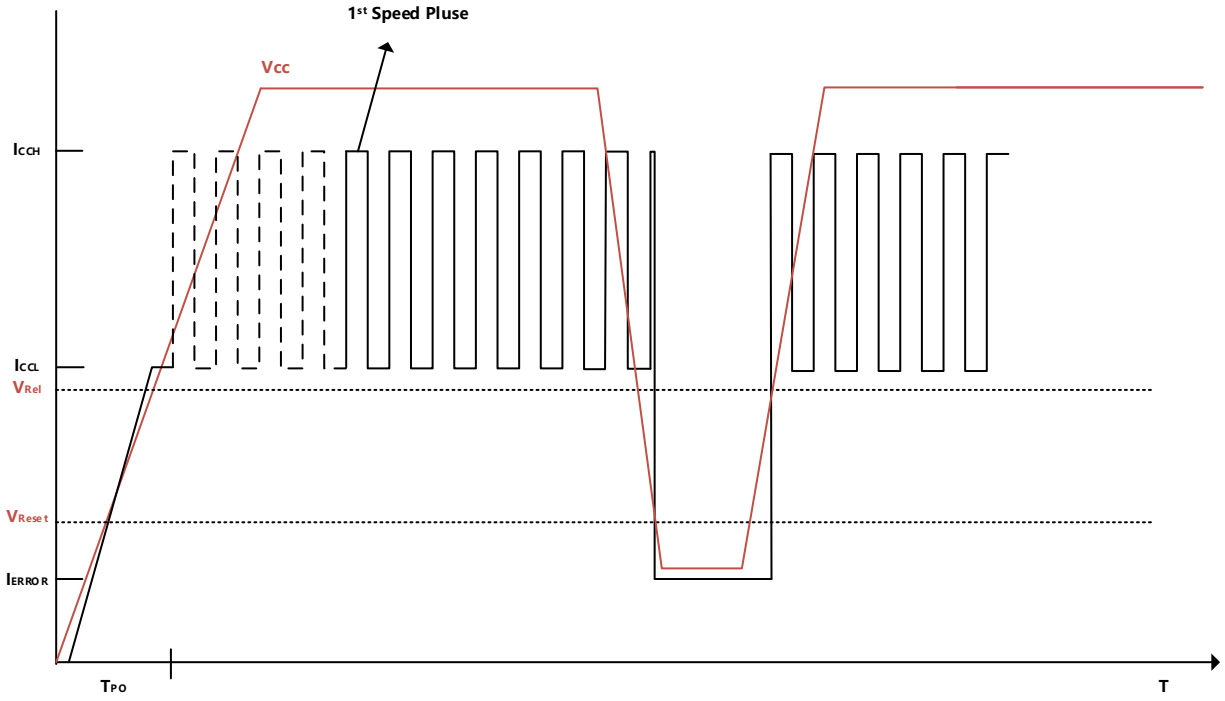


Figure.11 Undervoltage Behavior (Standard Protocol as Example)

If the V_{CC} lower than 3V (POR point), the chip will re-start

8 Application Circuit

8.1 Typical Application Circuit

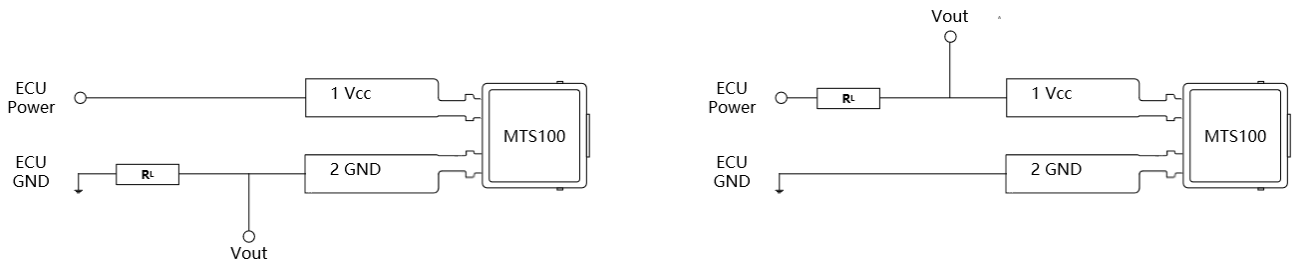
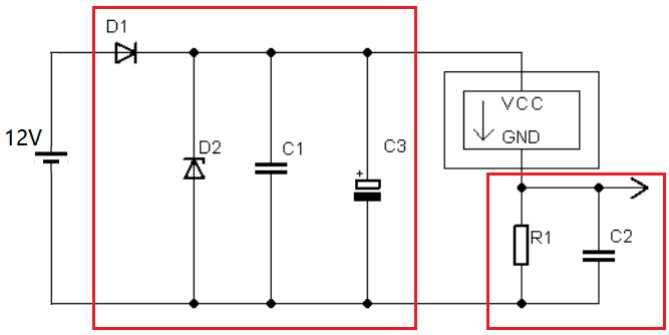


Figure.12 Typical Application Circuit

8.2 EMC Test Circuit



Components:

D1: Reverse polarity protection diode

D2: Zener diode with specific clamping voltage (e.g.27V)

C1: 10nF, 50V

C2: 1nF, 100V

C3: 10uF, 35V

R1: 75Ω

Figure.13 EMC Test Circuit

9 Package Material Information (For Reference Only – Not for Tooling Use)

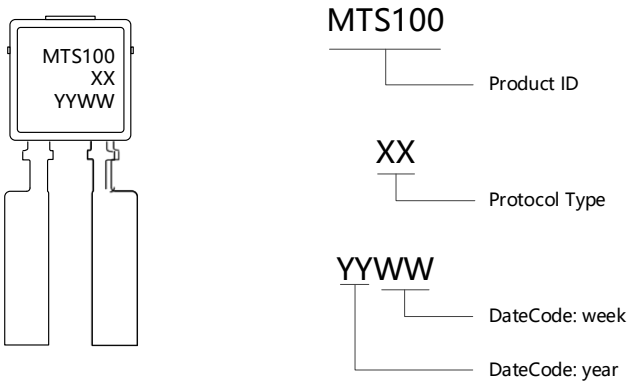


Figure.14 IMA-2L Chip Marking Spec

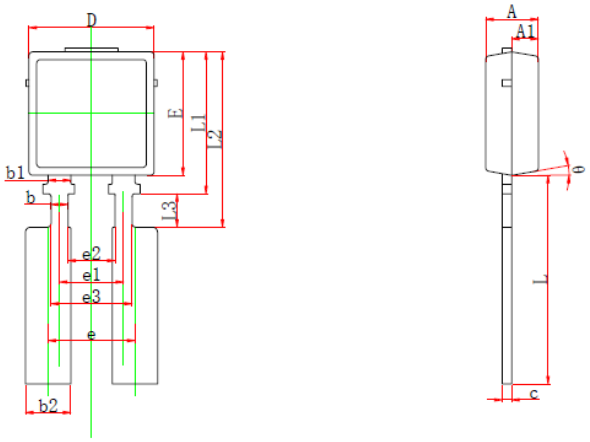


Figure.15 IMA-2L Package Drawing

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.450	0.053	0.057
A1	0.660	0.760	0.026	0.030
c	0.204	0.304	0.008	0.012
D	3.270	3.370	0.129	0.133
E	3.220	3.320	0.127	0.131
b	0.400	0.500	0.016	0.020
b1	0.550	0.650	0.022	0.026
b2	1.100	1.300	0.043	0.051
e	2.300		0.091	
e1	1.700		0.067	
e2	1.150	1.350	0.045	0.053
e3	2.050	2.250	0.081	0.089
L	5.380	5.680	0.212	0.224
L1	3.660	3.860	0.144	0.152
L2	4.500	4.800	0.117	0.189
L3	0.840	0.940	0.033	0.037
θ	9°	11°	9°	11°

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