TMR6306

## 100DPI 54mm TMR Magnetic Image Sensor

General Description

The TMR6306 is a 216pixels, 100DPI magnetic image sensor (MIS) module. It integrates proprietary TMR magneto-resistance sensor, high-quality magnet to provide high sensitivity performance. The TMR6306 module is designed for wide coverage paper bills, bank notes and security documents with magnetic materials and is suitable for scanning width up to 54mm. It features a 1-channel analog output to achieve a scanning rate of 50usec/line @ 5MHz pixel rate; Factory calibrated sensitivity of each pixel.

Key Features

- TMR sensor and magnet are integrated in one module
- 100DPI resolution, 54mm detection width with 216 pixels
- 1-channel analog output
- 50usec/line scanning speed
- Compact size: L64mm x W11.5mm x H15.2mm
- Built-in signal conditioner for each pixel
- Built-in sensitivity calibration in factory
- 3.3V power supply, 1.65V reference voltage output
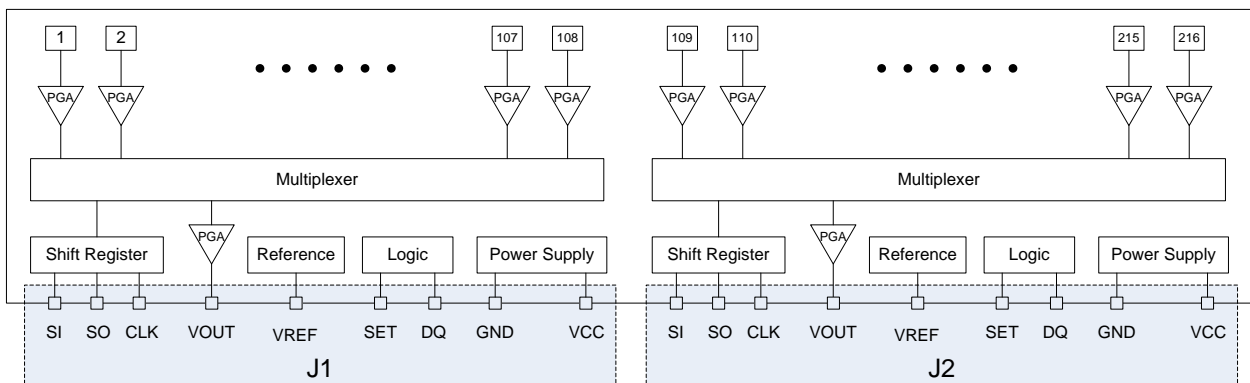- No built-in magnet is available: TMR6306N

Applications

- Currency Verification
- Magnetic Document Scanning
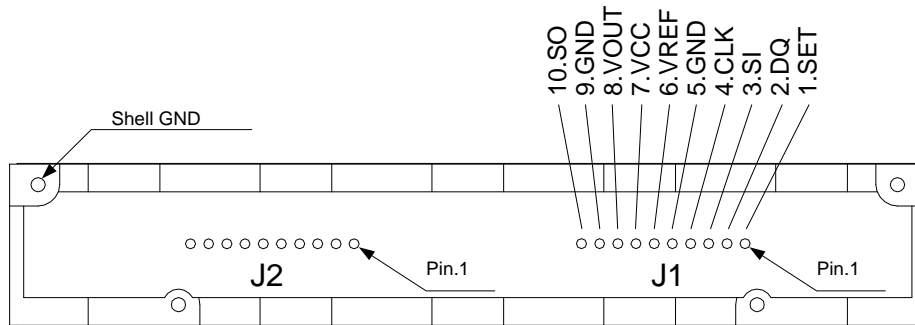- Non Destructive Testing
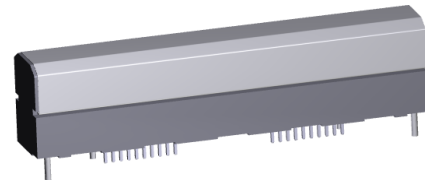
Ordering Information

Part Number	Built-in Magnet
TMR6306	Yes
TMR6306N	No

Block Diagram

Pin Configuration

Connector type: 10Pin 1.27mm pitch

Pin No. [1]	Symbol	I/O[2]	Description
1	SET	I	Auto-set bias voltage input. High-level for t_{SET} time to set the bias voltage of all pixels to the VREF
2	DQ	I/O	Test pin for factory settings, left it floating in normal use
3	SI	I	Sampling indication pulse input
4	CLK	I	Sampling clock pulse input
5, 9	GND	P	Ground
6	VREF	O	+1.65V Reference voltage output
7	VCC	P	+3.3V Power supply
8	VOUT	O	Analog output, each pixel signal is shifted out by sampling clock pulse
10	SO	O	Finished sampling indication pulse output

Note:

(1) J1, J2 are the same pin definition, the two connectors are independent, no internal connection between them

(2)   I – Input, O – Output, I/O – Input/Output, P – Power

Absolute Maximum Ratings

Parameter	Symbol	Limit	Unit
Maximum Supply Voltage Range	V_{CC}	-0.3 ~ 5.5	V
Input Voltage Range (EN,SET,DQ,SI,CLK)	V_{IN}	-0.3 ~ V_{CC}+0.3	V
Operating Temperature Range	T_A	-10 ~ 50	°C
Storage Temperature Range	T_{stg}	-30 ~ 85	°C
Operating Humidity Range	HMD	10 ~ 90 (no dew)	%RH

Electrical Characteristics

(V_{CC}=3.3V, T_A=25°C, unless otherwise noted.)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}		3.2		4	V
Current consumption	I_{CC}	VCC=3.3V, EN=High		0.36	0.5	A
Sampling frequency	f_S			5		MHz
Output voltage range	V_{OUT}		0.4		V_{CC} - 0.4	V
Auto-set Bias accuracy	V_{BIAS}	After auto-set bias	V_{REF} - 0.3	V_{REF}	V_{REF} + 0.3	V
Reference output voltage	V_{REF}		1.6	1.65	1.7	V
Output impedance	RV_{OUT}			500		Ohm
High-level input voltage	V_{IH}	SET, DQ, SI, CLK	$0.8V_{CC}$		V_{CC}	V
Low-level input voltage	V_{IL}		0		$0.2V_{CC}$	V
High-level output voltage	V_{OH}	DQ	$0.8V_{CC}$		V_{CC}	V
Low-level output voltage	V_{OL}		0		$0.2V_{CC}$	V
Noise	Noise	Gain=1024V/V		100		mVpp
High-pass filter frequency	HPF	-3dB		150		Hz
Low-pass filter frequency	LPF	-3dB		4		kHz
Gain range	Gain	Factory setting	10	1024	3800	V/V

Physical Characteristics

(V_{CC}=3.3V, T_A=25°C, unless otherwise noted.)

| Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Detection width	Width			54		mm
Number of magnetic detectors				216		pixels
Number of effective detectors				212		pixels
Pixel width	W			0.25		mm
Surface magnetic field	B	TMR6306		2000		Gs
		TMR6306N		0		
Magnetic sensitivity [2]	S	TMR6306		TBD		
		TMR6306N		TBD		

Note:

(1)   To provide good reference performance, a 0.1uF capacitor can be added between VREF and GND.

(2)   According to the MultiDimension sensitivity measurement.

Function Description

Function Sequences

The VCC is raise above the minimum supply voltage, the internal circuit will be setup within the delay time t_{ON}; when internal circuit power up, the SET pin is set to high-level for t_{SET} time, it will automatically set the bias voltage of each pixel to the VREF level; After auto-set bias finished for the delay time t_{SA}, then start sampling, a sampling indication signal is sent by setting SI_{J1} high-level at the falling edge of CLK, then the host can sample each pixel in sequence, after all pixels have been scanned, repeat the sampling indication signal on SI_{J1} again for the next line sampling.

This sequence corresponding circuit please refer to the "Typical Application Circuit".
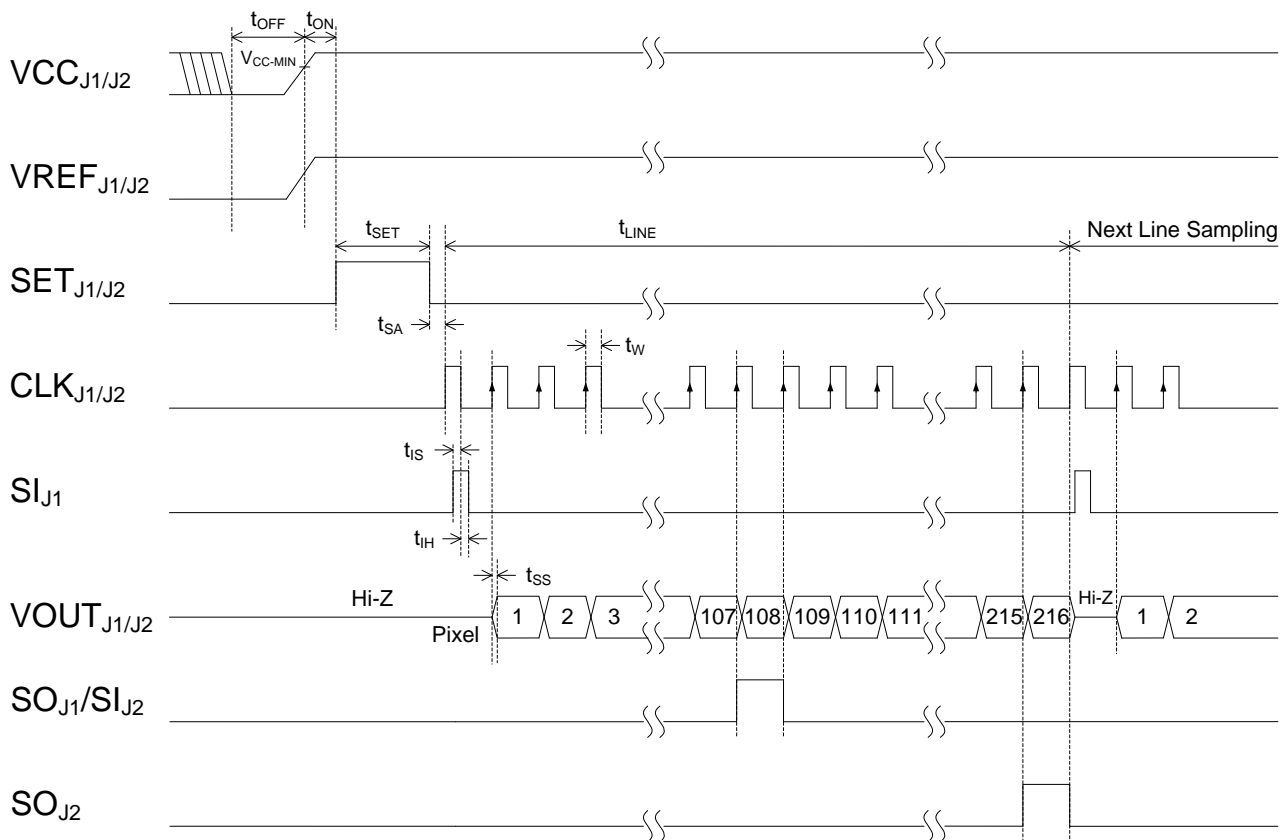
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power on delay time	t_{ON}	10			ms
Power off delay time	t_{OFF}	100			ms
Auto-set bias delay time	t_{SET}	100			ms
Line sampling rate	t_{LINE}		50		us
Sample delay time after auto-set bias	t_{SA}	1			ms
Clock pulse width	t_W	50			ns
Clock cycle time	t_{CLK}	200			ns
SI setup time	t_{IS}	25			ns
SI hold time	t_{IH}	25			ns
VOUT signal settling time	t_{SS}	150			ns

Power Supply

The external power supply should guarantee 0.5A or more current for TMR6306, the voltage drop should satisfy the minimum supply voltage requirement of the TMR6306. A logic enable pin controlled power supply is required for the power up and off sequence before the auto-set bias function.

Auto-set Bias Function

When power on, all pixels bias output voltage is different for offset variation. A logic high input on SET, the auto-set bias function will automatically adjust the bias output voltage of each pixel to the VREF; after a delay time of t_{SET}, a logic low input on SET will stop the auto-set bias function. During the auto-set bias function, make sure external magnetic field and environment is stable, do not roll the motors or bearings near TMR6306, otherwise it will take the signals as offset to adjust, then performs abnormal bias output voltage. A power off and power on sequence must be taken before starting the auto-set bias function.

Sampling Function

After auto-set bias function finished for the delay time t_{SA}, a logic high on SI captured at CLK falling edge will produce a start indication signal, it indicates the start of sampling function; VOUT is in Hi-Z state till the CLK rising edge of the first pixel occur; VOUT outputs each pixel signal on the rising edge of CLK pulse in sequence, the VOUT voltage is settled within the settling time t_{SS}, then the ADC can sample that pixel voltage; after all pixels have been sampled for t_{LINE} time, a new start indication signal can be produced to repeat next line sampling. Do not generate start indication signal until all pixels have been sampled.

Signal Conditioner Amplifier

TMR6306 features programmable gain amplifier for each pixel, it built-in band-pass filter to provide good SNR performance, especially suitable for the low frequency magnetic interferences immunity, like bearings, motors, adapters and etc.; the amplification can be adjusted in factory setting, normally it is 60dB, the amplifier transfer characteristic is as figure 2 shown. Each pixel's sensitivity can be calibrated independently in factory, the TMR6306 can provide high uniformity performance for dedicated application like banking machine, NDT and etc. For other gain requirements please contact MultiDimension.
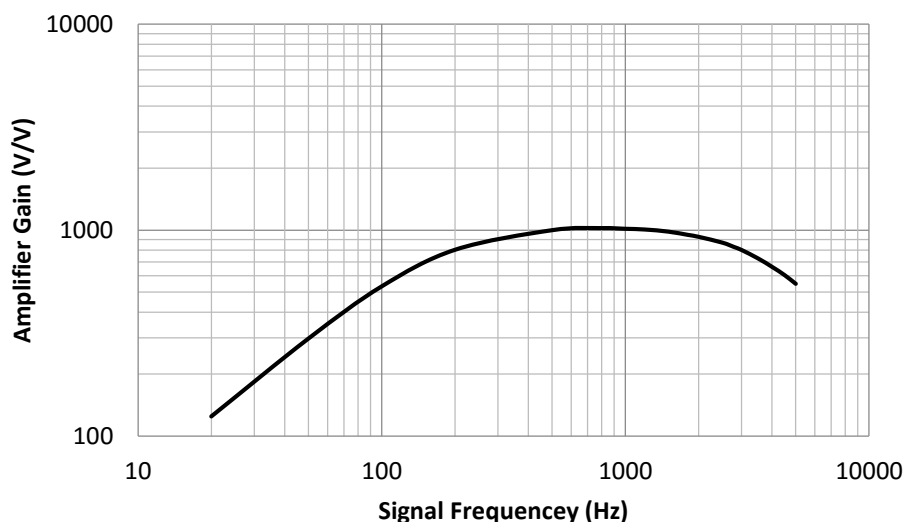
Figure 2. Band-pass amplifier transfer characteristics

Reference Voltage

A reference output voltage VREF pin is provided for the internal reference of the amplifier and also for the external amplifier reference source as in figure 3. The reference voltage is settled in t_{ON} time after powered on.
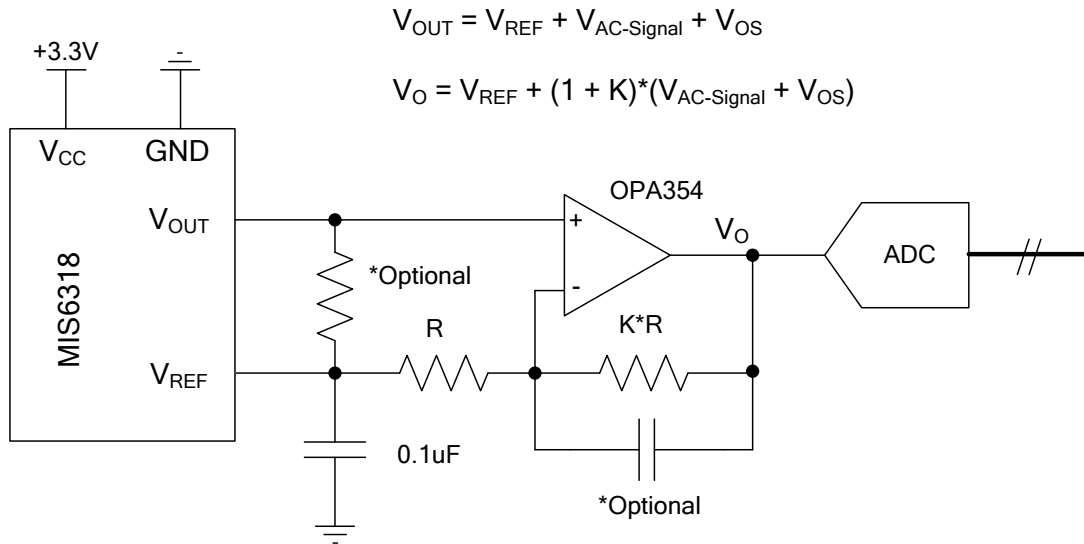
$$V_{OUT} = V_{REF} + V_{AC\text{-}Signal} + V_{OS}$$

$$V_O = V_{REF} + (1 + K)*(V_{AC\text{-}Signal} + V_{OS})$$

Figure 3. Reference for external amplifier

Sampling Rate

For example, set TMR6306 pixel sampling rate 5MHz, and line sampling rate is 43.2us/line of 216 pixels; if the paper bill is 156mm length in the moving direction, and its moving speed is 2m/s, it will take time 0.156m / (2m/s) = 0.078s to finish the scanning, and the number of sampling lines will be 0.078s / (43.2us/line) = 1805 lines, the sampling resolution will be 156mm / 1805 line = 0.086mm/line.

For higher sampling rate requirements please contact MultiDimension.

Caution for Use

■ The sensor contains a permanent magnet, it will cause the recordable magnetic media damaged, such as cassette tapes, floppy disks, credit cards, hard drives, keep it away from such types of magnetic media.

■ To avoid the ferromagnetic particles being collected from a dirty environment.

■ Magnets tend to snap to each other or the magnetic metals, be careful when handling the sensor not to apply mechanical shock, otherwise the sensors might be abnormal or break.

■ Do not place the sensor near the person who has an electronic medical device. It is very dangerous and may cause malfunction of an electronic medical device.

■ Magnetic devices may be subject to special transport regulations.

■ To avoid the abrasion of the sensor's metal case or stuck the banknote, about 0.1mm gap between the sensor and the opposite side such as rollers is recommended to reduce the pressure of the sensor's metal case.

■ To avoid excessive force on terminals, please mount the sensor's base firmly on the PCB and solder all the terminals.

■ Hand soldering should be applied, the soldering temperature should be $350\pm10^{o}C$ less than 3 seconds or $260\pm5^{o}C$ less than 10 seconds.
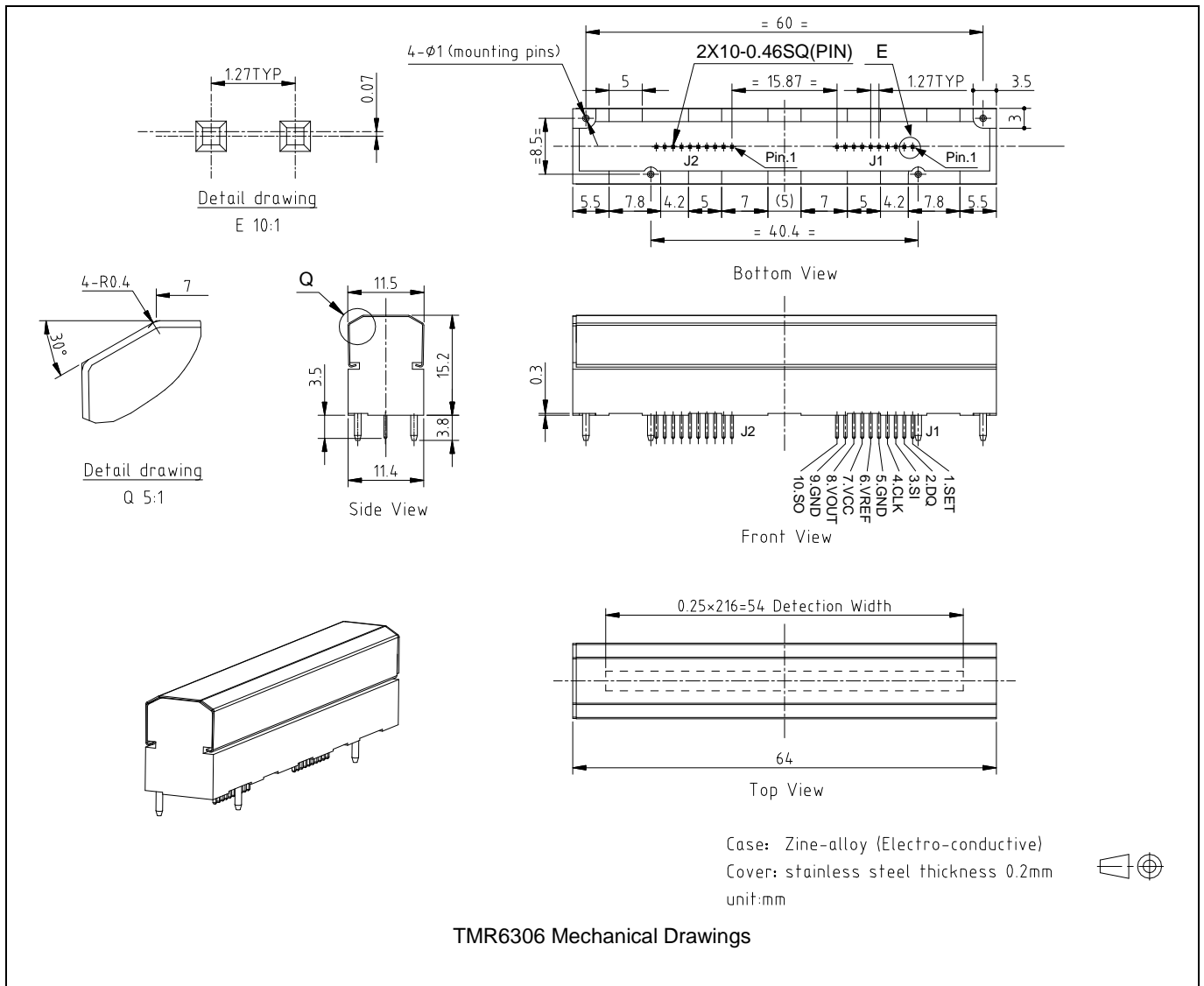
Typical Application Circuit
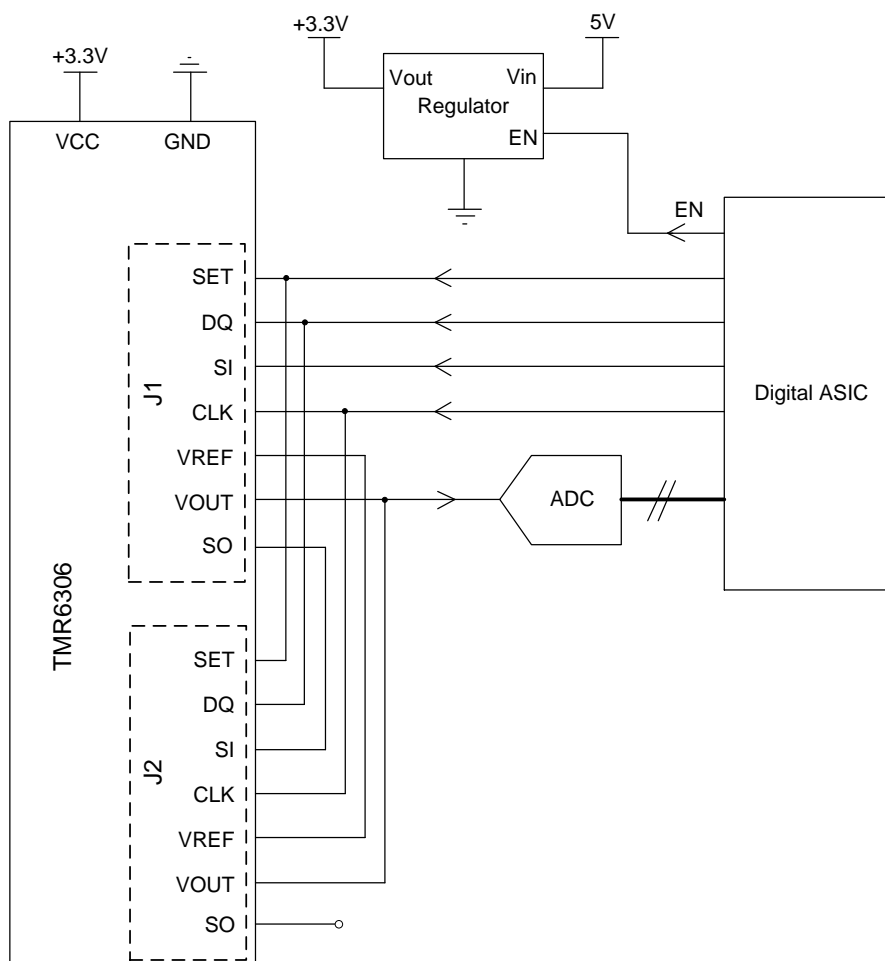
Notes:

The metal case or the cover should be connected to the shielding ground.

■ Mechanical Drawing & Dimensions

1.27TYP   0.07

Detail drawing
E 10:1

4-∅1 (mounting pins)   = 60 =

2X10-0.46SQ(PIN)   E

5   = 15.87 =   1.27TYP   3.5

3

≈ 8.5

J2   Pin.1   J1   Pin.1

5.5   7.8   4.2   5   7   (5)   7   5   4.2   7.8   5.5

= 40.4 =

Bottom View

4-R0.4   7

30°

Detail drawing
Q 5:1

Q   11.5

3.5   15.2

3.8

11.4

Side View

0.3

J2   J1

10.SO
9.GND
8.VOUT
7.VCC
6.VREF
5.GND
4.CLK
3.SI
2.DQ
1.SET

Front View

0.25×216=54 Detection Width

64

Top View

Case: Zine-alloy (Electro-conductive)
Cover: stainless steel thickness 0.2mm
unit:mm

TMR6306 Mechanical Drawings

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