

PRODUCT SPECIFICATION

TEM000045 Hydraulic Pressure Sensor for Brake Application

刹车液压压力传感器 TEM000045 产品规格书



DRAWN Mao Zhoubin		ENGINEER Mao Zhoubin	APPROVAL Sun Jiangtao	ECN #	DATE 24-Jun-2024
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Revision Log

Revision	Date	Changes
1	24-JUN-2024	1 st ISSUE

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1 概述 GENERAL DATA

1.1 描述 DESCRIPTION

本规格书描述了一款用于测量车用刹车系统液压压力的传感器。该传感器可输出数字式的压力和温度信号，同时客户可定制一系列诊断功能。

In this specification, the pressure sensor is described that has the objective to measure fluid pressure in the brake system of vehicle. It provides digital output of the pressure and temperature, with multiple diagnostic message which can be customized.

1.2 关键特性 KEY CHARACTERISTIC

- 极小的产品封装，更有利于系统布置
- Extremely small package for easier system layout
- 玻璃微溶技术，适合刹车应用
- Glass-bonded Strain Gage (GSG) technology for brake application
- SENT输出，符合SAE J2716 JAN2010 and APR2016
- SENT output, compliant for SAE J2716 JAN2010 and APR2016 specification
- 全桥（P1），半桥（P2）和温度信号皆可输出
- Full bridge (P1), half bridge (P2) and temperature output available
- 可靠的的压接安装方式
- Reliable clinch installing feature
- 可靠的弹簧电气连接
- Reliable spring electrical connection
- 最高满足ASIL-C的功能安全等级
- Meet up to ASIL-C safety applications
- 车规级产品
- Automotive Qualified

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2 产品特性CHARACTERISTICS

2.1 绝对极限指标 ABSOLUTE LIMIT RATINGS

绝对极限指标是指产品对外部应力（环境、机械、电气）的耐受能力。应力超过下表的情况可能造成产品的永久损坏。产品在绝对极限指标下的功能不能保证且可能影响产品的耐久可靠性。另外，产品在超过2.2章节的推荐条件以上的情况也可能影响产品的耐久可靠性。

The absolute limit ratings are stress rating only. Stress out of the range in the list below can cause permanent damage to the device. Functional operation of the device at absolute limit ratings is not guaranteed and might affect device reliability. In addition, extended exposure to stressed above the recommended operating conditions listed in section 2.2 also might affect device reliability.

Item	Description	Min	Max	Unit
1	供电电压 Supply voltage	-18	18	V
2	输出端子电压 Voltage at OUT pin	-18	18	V
3	任意两个端子间的电压差 Pin voltage difference between any two of the pins	-18	18	V
4	使用温度 Operation Temperature	-40	150	°C
5	存储温度 Storage Temperature	-40	150	°C

2.2 产品参数PRODUCT PARAMETER

Item	Description	Rating
1	供电电压 Operation Supply Voltage (Vcc)	4.75~5.25 V
2	扩展供电电压，精度下降 Extended Operation Supply Voltage, degraded accuracy	4.5~5.5 V
3	消耗电流 Current Consumption	10mA Max
4	外界负载 Output Load	10kohm Pull-up
5	工作温度 Operation Temperature	-40~125 °C
6	存储温度 Storage Temperature	-40~125 °C
7	输出信号 Output Type	SENT
8	满量程压力 Full Scale Pressure	250 Bar
9	耐受压力 Proof Pressure	300 Bar
10	爆破压力 Burst Pressure	400 Bar
11	应用介质 Application Medium	Brake fluid
12	启动时间，上电后至第一个有效输出 Start-up Time, Time to first valid output after power-on	20ms Max
13	响应时间，节拍时间=3us，SENT 暂停=on，帧长度设置最小 Response Time, tick time=3us, SENT pause=on, frame length set to minimum	10ms Max

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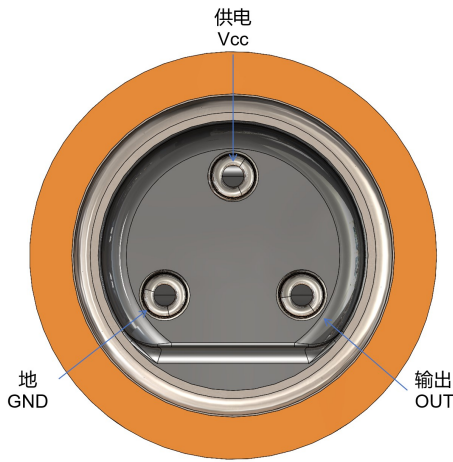
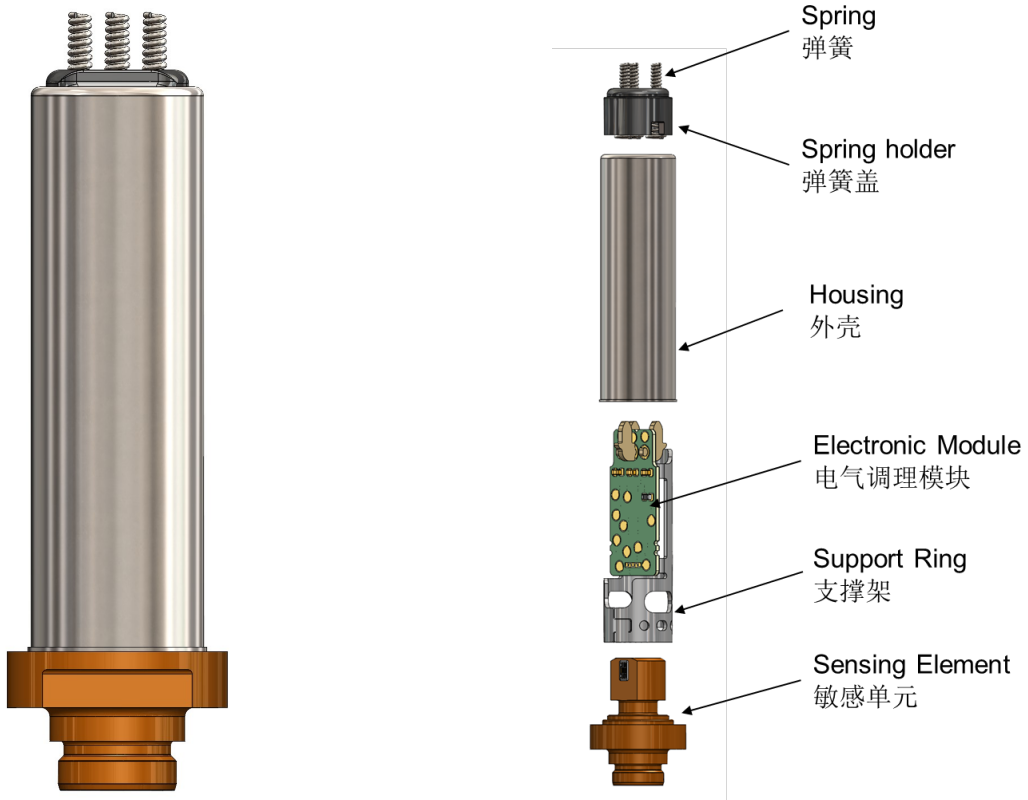
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2.3 产品设计概况 DESIGN OVERVIEW



传感器的详细尺寸请参考图纸。

Refer to sensor ENV drawing for the detailed dimension of product.

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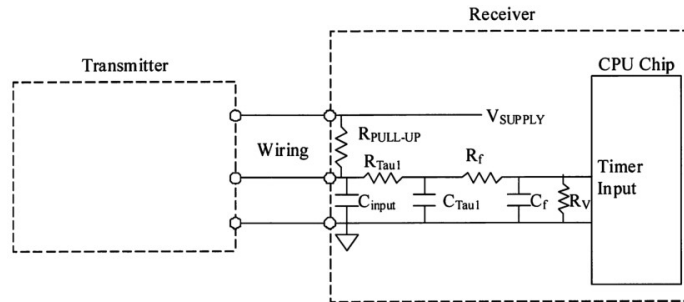
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2.4 应用接口 APPLICATION INTERFACE

- 压接力 Clinch force: Max.15kN
- 安装空间高度 Interface height: 从压接平面开始26.6至27.6mm 26.6~27.6mm from clinch surface
- 电气参考接口 Reference electrical circuit



系统接口电路仅供参考，不能直接使用，必须结合实际的应用条件衡量是否需要
进行更改。

The system interface circuit is only for reference and should not be taken as a direct use. Actual considerations should be taken into account according to specific application.

传感器的详细接口尺寸请参考图纸。

Refer to sensor ENV drawing for the detailed dimension of application interface.

2.5 传感器输出 SENSOR OUTPUT

- P1传输曲线 P1 Transfer Curve : $193+3704*P(\text{bar})/250$
- P2传输曲线 P2 Transfer Curve : $3897-3704* P(\text{bar})/250$
- 低钳位 Low Clamp : 1
- 高钳位 High Clamp : 4088
- P1欠压范围 P1 Under Pressure Range : 1-192
- P2欠压范围 P2 Under Pressure Range : 3898-4088
- P1过压范围 P1 Over Pressure Range : 3898-4088
- P2过压范围 P2 Over Pressure Range : 1-192
- 温度传输曲线 Temperature Transfer Curve : $585+8*T(^{\circ}\text{C})$
- 压力精度 Accuracy for Pressure

	Initial Life				Post Life			
	P1		P2		P1		P2	
	%FS	Bar	%FS	Bar	%FS	Bar	%FS	Bar
0 ~ 50bar	±1.5	±3.75	±1.8	±4.50	±2.1	±5.25	±2.8	±7.00
50 ~ 150bar	±1.8	±4.50	±2.1	±5.25	±2.8	±7.00	±3.4	±8.50
150 ~ 250bar	±2.1	±5.25	±2.4	±6.00	±3.1	±7.75	±3.7	±9.25

- 温度精度 Accuracy for Temperature

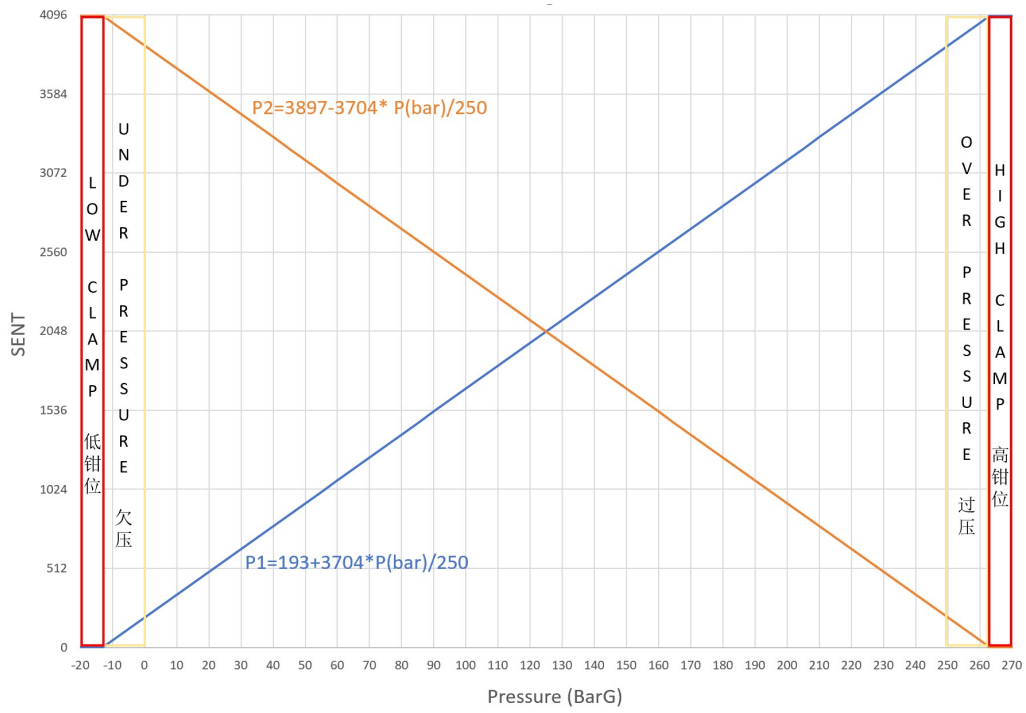
- 全寿命周期 Initial & Post life : $\pm 10^{\circ}\text{C}$

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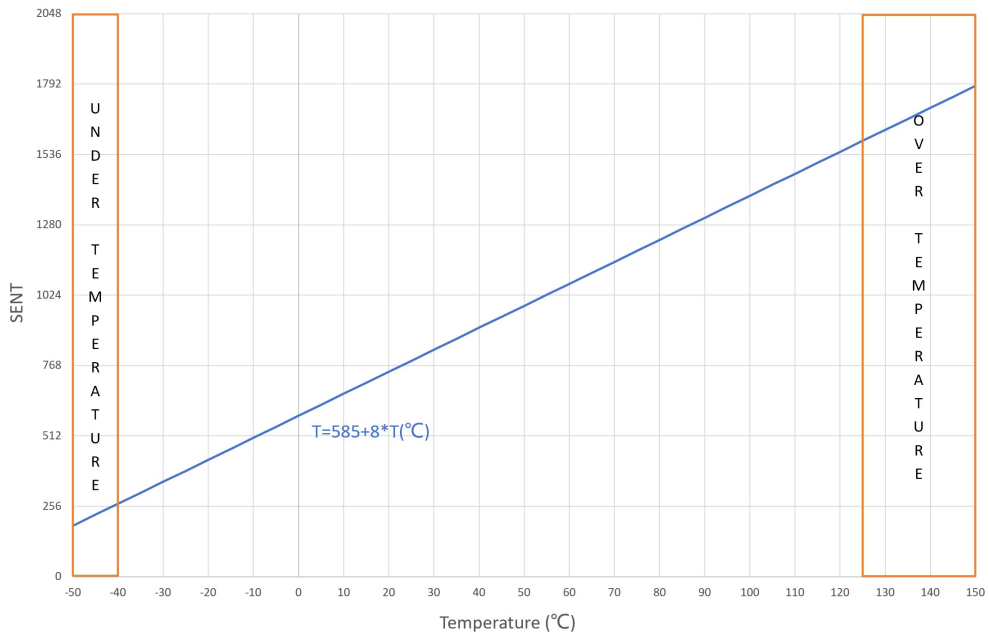
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压力传输曲线 Pressure Transfer Curve



温度传输曲线 Temperature Transfer Curve

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2.6 SENT协议 SENT PROTOCOL

该产品输出信号为单边半字传输协议（SENT）协议，符合SAE J2716 JAN2010和APR2016规范。SENT是从传感器发送设备到控制器/接收设备的单向通信方案，不包括来自控制器/接收设备的协调信号。传感器信号以一系列脉冲(称为“Nibbles”)的形式传输，数据编码为下降沿周期。信号编码的细节可能因本规范的各种附录中描述的特定传感器应用而有所不同。

The sensor has a Single Edge Nibble Transmission encoding scheme (SENT) output protocol, which is compliant for SAE J2716 JAN2010 and APR2016 specification. SENT is unidirectional communications scheme from sensor transmitting device to controller /receiving device which does not include coordination signal from the controller/receiving device. The sensor signal is transmitted as series of pulses (Known as “Nibbles”) with data encoded as falling to falling edge periods. Details of the signal encoding may vary for specific sensor applications described in various appendices of this specification.

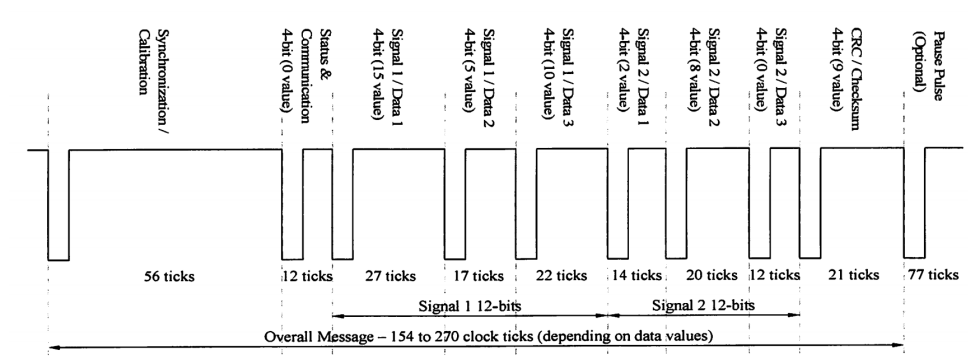


图2.6.1

图2.6.1显示了12位传感器输出的单个消息传输示例，假设时钟周期为3微秒。最短的消息由154个时钟节拍组成，最长的消息是270个时钟节拍，取决于信号的数值。

Figure 2.6.1 shows an example single message transmission for two 12-bit sensor values assuming microsecond clock tick. Note that the shortest length message consists of 154 clock ticks. Similarly, the longest message is 270 clock ticks.

信号脉冲长度将根据它们所携带的价值而变化。超过4个时钟节拍为低电平，所有剩余时钟节拍为高电平。最小的脉冲是12个节拍，其值为0。最大的脉冲是27个节拍，其值为15。如图2.6.2和表2.6.1。

The Nibble length will vary according to the value they carry. More than 4 clock ticks driven low time, all remaining clock ticks driven high. The minimum nibble pulse is 12 ticks, which present the value of 0. The maximum nibble pulse is 27 ticks, which present the value of 15. See example in figure 2.6.2 and table 2.6.1.

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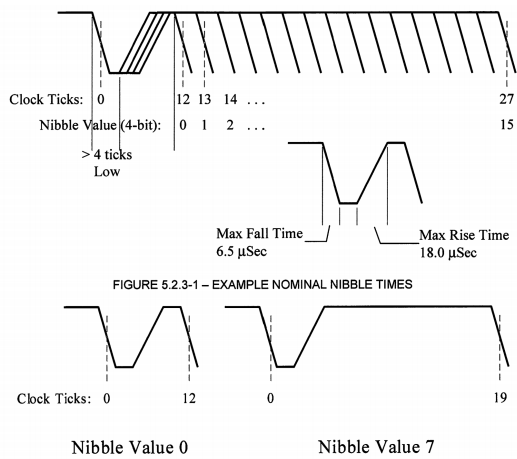


图2.6.2

表2.6.1

	in.	Typ.	Max.
Tick time (μs)	2.8	3	3.2
Fall time (μs)	1.25	-	6.5
Rise time (μs)	2.8	-	18
Low time (ticks)	4	-	-
Nibble length (ticks)	12	-	27

SENT信号传输遵循以下顺序：

The SENT transmission consists of the following sequence:

- 同步脉冲：

- SYNCHRONIZATION NIBBLE:

标称脉冲周期为56个时钟节拍。起始有超过4个时钟节拍为低电平，所有剩余时钟节拍为高电平。接收模块会测量实际周期，从而校正发射机时钟变化。

The nominal pulse period is 56 clock ticks. More than 4 clock ticks driven low time, all remaining clock ticks driven high. Actual period measured by receiving module to correct for transmitter clock variation.

- 状态脉冲：

- STATUS NIBBLE:

这个脉冲是为了使传感器能够传输诸如诊断消息、温度数据和故障标志等杂项信息。脉冲的定义如下表所示。使用串行消息位传送的信号也被称为“慢速通道”信号。

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This nibble is reserved to enable the sensor to transmit miscellaneous information such as diagnostic message, temperature data, and fault flags. The nibble is defined in the following table. The signals conveyed using the serial message bits are also referred as “Slow Channel” signals.

状态脉冲的定义见表2.6.2，每18个消息帧传递一个慢通道消息。

The status nibble is defined in the following table 2.6.2. The status nibble from 18 message frames conveys a single slow channel message.

表 2.6.2

Bit Number	Bit Function
0 (least significant)	Reserved for specific application
1	Reserved for specific application
2	Serial Data message bits
3 (most significant)	Message start = 1, otherwise = 0 or Serial data message bits

SENT Frame:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Bit 3 (MSB)	1	1	1	1	1	1	0	0	8-bit ID (7-4)			0	8-bit ID (3-0)			0		
Bit 2	6-bit CRC						12-bit data											
Bit 1	Reserved for fault indicators																	
Bit 0 (LSB)	Reserved for fault indicators																	

慢速通道消息将在诊断消息(8位ID = 0x01)和温度数据(8位ID = 0x10)之间交替。

The Slow Channel message will alternate between Diagnostic message (8-bit ID = 0x01) and Temperature data (8-bit ID = 0x10).

- 快速通道1

- FAST CHENNEL 1:

这是一个12位的数据，分成3个脉冲，首先读取Most Significant Nibble (MSN)。该快速通道用于传输P1数据。

This is a 12-bit data divided into 3 nibbles and is read Most Significant Nibble (MSN) first. This Fast Channel is used to transmit P1 data.

此快速通道的故障报告将使用状态脉冲位0，不会中断P1数据传输。

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Fault reporting for this Fast Channel will use the Status Nibble Bit 0 and will not interrupt the P1 data transmission.

- 快速通道2:

- FAST CHENNEL 2:

这是一个12位的数据，分成3个m脉冲，首先读取最小有效小块(LSN)。该快速通道用于传输P2数据。

This is a 12-bit data divided into 3 nibbles and is read Least Significant Nibble (LSN) first. This Fast Channel is used to transmit P2 data.

此快速通道的故障报告将使用状态脉冲位1，不会中断P2数据传输。

Fault reporting for this Fast Channel will use the Status Nibble Bit 1 and will not interrupt the P2 data transmission.

- 4位CRC

- 4-BIT CYCLIC REDUNDANT CHECK (CRC):

此脉冲基于快速通道1和2的数据提供了一个4位校验和。此校验和使用SENT标准中描述的256个元素的数组来实现。

This nibble provides a 4-bit checksum based on the data from Fast Channel 1 and 2. This checksum is implemented using a 256 element array as described in the SENT standard.

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