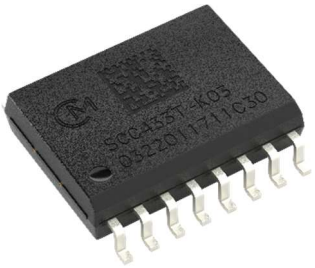
Data Sheet



SCC400T Series

SCR410T-K03 X gyroscope with digital SPI interface
SCC433T-K03 XZ gyroscope and XYZ accelerometer with digital SPI interface

Features

- ±300°/s X- or X/Z-axis angular rate measurement range
- ±6g 3-axis acceleration measurement range (XYZ, SCC433T-K03 only)
- ±8g 3-axis acceleration measurement range (XYZ, SCC433T-K03 only)
- −40°C…+110°C operating temperature range
- 3.0V…3.6V supply voltage
- SPI digital interface
- Extensive self-diagnostics features
- Housing body size 10.4 x 7.65 x 2.3 mm (l × w × h)
- RoHS compliant robust SOIC plastic package suitable for lead free soldering process and SMD mounting
- Proven capacitive 3D-MEMS technology

Applications

SCC400T series is targeted at applications demanding high stability with tough environmental requirements. Typical industrial applications include:

- Inertial Measurement Units (IMUs)
- Robotic control systems
- Machine control systems
- Platform stabilization and control
- Motion analysis and control

Restriction

- https://www.murata.com/en-global/support/militaryrestriction

Overview

SCC433T-K03 is a combined high performance angular rate and accelerometer sensor component based on Murata's proven capacitive 3D-MEMS technology. Signal processing is done in one mixed signal ASIC that provides angular rate and acceleration output via flexible SPI digital interface. Sensor elements and ASIC are packaged to overmolded SOIC-16W plastic housing that guarantees reliable operation over product's lifetime.

SCR410T-K03 is a high performance angular rate sensor component based on the same technology, housing and SPI digital interface as SCC433T-K03.

SCC433T-K03 and SCR410T-K03 are designed, manufactured and tested for high stability, reliability and quality requirements. Components have extremely stable output over temperature, humidity and vibration. Components have several advanced self-diagnostic features and it is suitable for SMD mounting and is compatible with RoHS and ELV directives.

1 Introduction

This document contains essential technical information related to all SCC400T series sensors including specifications, SPI interface descriptions, user accessible register details, electrical properties and application information. This document together with the document "APP 10207 Assembly instructions for SCC400T Series" should be used as a reference when designing in SCC400T series component. All content of this document is not valid for all product versions, please see below for register and functionality validity.

Table 1. Register and functionality validity for SCC400T series product versions.

	SCC433T-K03	SCR410T-K03
X-gyro functionality (±300°/s)	☒	☒
Z-gyro functionality (±300°/s)	☒	☐
ACC functionality (±6g)	☒	☐
ACC LGS functionality (±8g)	☒	☐
Temperature sensing functionality	☒	☒

2 Specifications

This chapter includes all specifications, typical performance and general information for SCC400T series.

2.1 Abbreviations

ASIC	Application Specific Integrated Circuit
SPI	Serial Peripheral Interface
RT	Room Temperature
DPS	Degrees per second
FS	Full scale
OS	Out of specification
CSB	Chip Select
SCK	Serial Clock
MOSI	Master Out Slave In
MISO	Master In Slave Out
MCU	Microcontroller
LGS	Secondary accelerometer output
BIST	Built-in Self test
DSP	Digital Signal Processor
CCM	Channel calibration and monitoring
Rx	Rate X axis
Rz	Rate Z axis
Ax	Accelerometer X axis
Ay	Accelerometer Y axis
Az	Accelerometer Z axis
F_prim	Nominal operation frequency of the sensor element
DOF	Degrees of Freedom

2.2 Performance Specifications for Gyroscope

Table 2.Performance specifications with VDD = 3.3 V and at room temperature (RT) unless otherwise specified.

Parameter	Condition	Unit	SCC400T series SCC433T-K03 and SCR410T-K03			
			Axis	Min *	Typ *	Max *
Operating temperature range **		°C	X/Z	-40		110
Measurement range **		°/s	X/Z	-300		300
Total offset error	-40 °C ... +110 °C	°/s	X	-1.2		1.2
			Z	-0.7		0.7
Offset drift over lifetime ***	After HTOL 1000h	°/s	X	-0.9		0.9
			Z	-0.4		0.4
Offset drift over temperature	-40 °C ... +110 °C	°/s	X	0		0.8
			Z	0		0.4
Offset drift velocity	2.5K /min, -40 °C ... +110 °C	°/s / min	X	-0.1		0.1
			Z	-0.05		0.05
Sensitivity	Target value	LSB/°/s	X/Z		80	
Total sensitivity error (lifetime)	-40 °C ... +110 °C	%	X	-3		3
			Z	-1		1
Linearity error	-300dps ... +300dps, -40 °C ... +110 °C	°/s	X	-0.5		0.5
			Z	-0.4		0.4
	-250dps ... +250dps, -40 °C ... +110 °C	°/s	X	-0.4		0.4
			Z	-0.3		0.3
Noise (RMS)	13 Hz filter, -40 °C ... +110 °C	°/s	X/Z		0.009	0.014
	20 Hz filter, -40 °C ... +110 °C	°/s	X/Z		0.011	0.017
	46 Hz filter, -40 °C ... +110 °C	°/s	X/Z		0.015	0.025
	200Hz filter, -40 °C ... +110 °C	°/s	X/Z		0.1	0.15
	200Hz filter, -40 °C ... +110 °C Gyro CST disabled	°/s	X/Z		0.05	0.1
	300Hz filter, -40 °C ... +110 °C	°/s	X/Z		0.05	0.1
Noise density	-40 °C ... +110 °C	°/s/√Hz	X/Z		0.002	
Angle Random Walk		°/√h	X/Z		0.09	
Bias Instability	Allan Variance minimum	°/h	X		1.3	
			Z		1.1	
	Allan Variance minimum divided by 0.664	°/h	X		1.9	
			Z		1.6	
Cross-axis sensitivity	-40 °C ... +110 °C	%	X/Z	-1.5		1.5
Amplitude response −3 dB frequency	13 Hz filter	Hz	X/Z		13	
	20 Hz filter	Hz	X/Z		20	
	46 Hz filter	Hz	X/Z		46	
	200 Hz filter	Hz	X/Z		219	
	300 Hz filter	Hz	X/Z		299	
Power on start-up time **	13, 20 Hz filter (after SPI power on command)	ms	X/Z			620
	46, 200, 300 Hz filter (after SPI power on command)	ms	X/Z			500
F_prim ** Nominal operation frequency of the sensor element. All ASIC internal clocks are derived from a multiple of this frequency		kHz	X	15.8	16.8	17.8
			Z	18.3	19.3	20.3
Electrical Dynamic Range (Headroom)	Output signal	°/s	X/Z		±409.6	
Output update rate		kHz	X/Z		F_prim/2	
G sensitivity (1g x,y,z axis)	DC gravity input	(°/s)/G	X/Z	-0.01		0.01

* Specified Min/Max values contain ±3 sigma variation limits of original test population. Typical values are validation population mean (unless otherwise specified). Min/Max and typical values are not guaranteed, values represent validation population characteristics.
** Guaranteed value
*** Min/max values are example of original test population ±3 sigma limits, values not guaranteed.

Note :
• Specification is valid after 24hours from reflow.
• Each system design including SCC400T series component must be evaluated by the customer in advance to guarantee proper functionality during operation.

Table 3. Gyroscope parameter definitions

Parameter	Description
Total offset error	Includes offset error from calibration, temperature, supply voltage and drift over lifetime. Lifetime tests include following tests listed in AEC-Q100: TC, HTSL, HTOL, HBM, CDM, LU, MS, VFV, CA, DROP. Statistical mean and ±3sigma is evaluated only for tests with N ≥ 30pcs.
Offset drift over lifetime	Offset change in room temperature (RT) during HTOL test, offset zeroed to initial measurement, N ≥ 90pcs HTOL: 1000 hours of high temperature operating life at +125°C, VDD=3.6V.
Offset drift over temperature	Offset drift over temperature is determined by ((maximum offset value over temperature) - (minimum offset value over temperature)) / 2 in condition of one temperature sweep in specified temperature range.
Sensitivity	Sensitivity is defined as $Sensitivity = \frac{AR_{meas}(\Omega_{max}) - AR_{meas}(\Omega_{min})}{\Omega_{max} - \Omega_{min}}$ Where Ω_{max}=applied angular rate at maximum operating range Ω_{min}=applied angular rate at minimum operating range $AR_{meas}(\Omega_n)$ = measured angular rate at Ω_n [LSB]
Total sensitivity error	Includes sensitivity error from calibration, temperature, supply voltage and drift over lifetime. Lifetime tests listed in total offset error.
Linearity error	Linearity is the maximum deviation from the straight line defined by the measured values at the operating range endpoints.
Cross-axis sensitivity	Cross axis sensitivity is the ratio between the sensitivity of the sensing axis and the two orthogonal axes. Xgyro product version： $Cross\ axis\ (Y) = \frac{Sensitivity(Y)}{Sensitivity(X)} \times 100\%, Cross\ axis\ (Z) = \frac{Sensitivity(Z)}{Sensitivity(X)} \times 100\%$ Zgyro product version： $Cross\ axis\ (X) = \frac{Sensitivity(X)}{Sensitivity(Z)} \times 100\%, Cross\ axis\ (Y) = \frac{Sensitivity(Y)}{Sensitivity(Z)} \times 100\%$ Where Sensitivity(X)= Sensitivity when angular rate is applied in X direction Sensitivity(Y)= Sensitivity when angular rate is applied in Y direction Sensitivity(Z)=Sensitivity when angular rate is applied in Z direction

2.3 Performance Specifications for Accelerometer

Table 4. Performance specifications with VDD = 3.3 V and at room temperature unless otherwise specified.

Parameter	Condition	Unit	SCC400T series SCC433T-K03			
			Axis	Min *	Typ *	Max *
Operating temperature range **		°C	X/Y/Z	-40		110
Measurement range **		g	X/Y/Z	-6		6
Total Offset error	-40 °C ... +110 °C	mg	X/Y	-25		25
			Z	-45		45
Offset drift over lifetime ***	In RT, after HTOL 1000h	mg	X/Y	-17		17
			Z	-25		25
Offset drift over temperature	-40 °C ... +110 °C	mg	X/Y	0		15
			Z	0		20
Offset drift velocity	2.5K /min, -40 °C ... +85 °C	mg / min	X/Y/Z	-3		3
	2.5K /min, -40 °C ... +110 °C	mg / min	X/Y/Z	-6		6
Sensitivity	Target value	LSB/g	X/Y/Z		4905	
Total sensitivity error	−1 g …1 g range, -40 °C ... +110 °C	%	X/Y	-0.5		0.5
			Z	-0.6		0.6
Linearity error	−1 g …1 g range	mg	X/Y/Z	-1		1
	−1 g …1 g range, -40 °C ... +110 °C	mg	X/Y/Z	-5		5
	−6 g …6 g range, -40 °C ... +110 °C	mg	X/Y	-30		30
			Z	-45		45
Cross-Axis sensitivity	per axis	%	X/Y/Z	-1.5		1.5
Noise (RMS)	13 Hz filter, -40 °C ... +110 °C	mg	X/Y/Z		0.35	0.5
	20 Hz filter, -40 °C ... +110 °C	mg	X/Y/Z		0.4	0.7
	46 Hz filter, -40 °C ... +110 °C	mg	X/Y/Z		0.6	0.8
	200Hz filter, -40 °C ... +110 °C	mg	X/Y/Z		1.5	4
	300Hz filter, -40 °C ... +110 °C	mg	X/Y/Z		2	5
Noise density	-40 °C ... +110 °C	$\mu g/\sqrt{Hz}$	X/Y/Z		70	
Amplitude response −3 dB frequency	13 Hz filter	Hz	X/Y		13	
	20 Hz filter	Hz	X/Y		20	
	46 Hz filter	Hz	X/Y		46	
	200 Hz filter	Hz	X/Y		198	
	300 Hz filter	Hz	X/Y		251	
	13 Hz filter	Hz	Z		13	
	20 Hz filter	Hz	Z		20	
	46 Hz filter	Hz	Z		46	
	200 Hz filter	Hz	Z		208	
	300 Hz filter	Hz	Z		272	
Power on start-up time **	13, 20 Hz filter (after SPI power on command)	ms	X/Y/Z			450
	46, 200, 300 Hz filter (after SPI power on command)	ms	X/Y/Z			320
Electrical Dynamic Range (Headroom)		g	X/Y/Z		±6.7	
Output update rate	Accelerometer: X-gyro F_prim	kHz	X/Y/Z		F_prim/2	

* Specified Min/Max values contain ±3 sigma variation limits of original test population. Typical values are validation population mean (unless otherwise specified). Min/Max and typical values are not guaranteed, values represent validation population characteristics.

** Guaranteed value

*** Example of test population ±3 sigma limits, values not guaranteed.

Note :

- Specification is valid after 24hours from reflow.
- Each system design including SCC400T series component must be evaluated by the customer in advance to guarantee proper functionality during operation.

2.4 Performance Specifications for Secondary Accelerometer Output

Table 5. Performance specifications with VDD = 3.3 V and at room temperature unless otherwise specified.

Parameter	Condition	Unit	SCC400T series SCC433T-K03			
			Axis	Min *	Typ *	Max *
Operating temperature range **		°C	X/Y/Z	-40		110
Measurement range **		g	X/Y/Z	-8		8
Total Offset error	-40 °C ... +110 °C	mg	X/Y	-25		25
			Z	-45		45
Offset drift over temperature	-40 °C ... +110 °C	mg	X/Y	0		15
			Z	0		20
Sensitivity	Target value	LSB/g	X/Y/Z		2452.5	
Total sensitivity error	−1 g …1 g range, -40 °C ... +110 °C	%	X/Y	-0.5		0.5
			Z	-0.6		0.6
Linearity error	−1 g …1 g range	mg	X/Y/Z	-1		1
	−1 g …1 g range, -40 °C ... +110 °C	mg	X/Y/Z	-5		5
	−8 g …8 g range, -40 °C ... +110 °C	mg	X/Y	-50		50
			Z	-100		100
Cross-Axis sensitivity	per axis	%	X/Y/Z	-1.5		1.5
Noise (RMS)	200Hz filter, -40 °C ... +110 °C	mg RMS	X/Y/Z		1.5	4
	300Hz filter, -40 °C ... +110 °C	mg RMS	X/Y/Z		2	5
Amplitude response −3 dB frequency	200 Hz filter	Hz	X/Y		198	
	300 Hz filter	Hz	X/Y		251	
	200 Hz filter	Hz	Z		208	
	300 Hz filter	Hz	Z		272	
Output update rate	Accelerometer: X-gyro F_prim	kHz	X/Y/Z		16× F_prim	

* Specified Min/Max values contain ±3 sigma variation limits of original test population. Typical values are validation population mean (unless otherwise specified). Min/Max and typical values are not guaranteed, values represent validation population characteristics.

** Guaranteed value

Note :

• Specification is valid after 24hours from reflow.

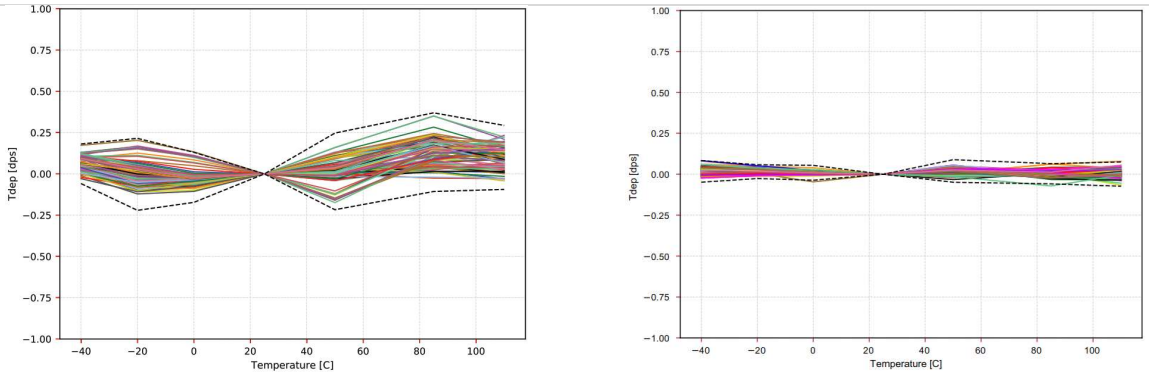
• Each system design including SCC400T series component must be evaluated by the customer in advance to guarantee proper functionality during operation.

Table 6. Accelerometer and secondary accelerometer parameter definitions

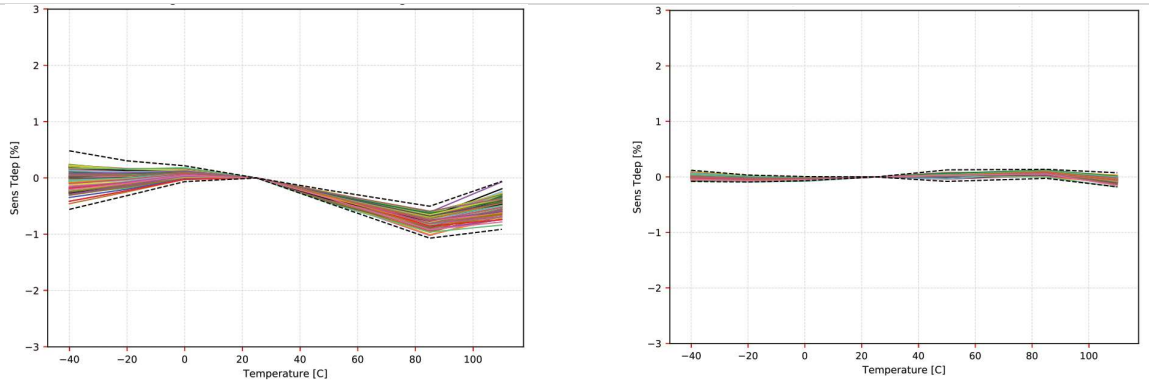
Parameter	Description
Total Offset error	Includes offset error from calibration, temperature, supply voltage and drift over lifetime. Lifetime tests include following tests listed in AEC-Q100: TC, HTSL, HTOL, HBM, CDM, LU, MS, VFV, CA, DROP. Statistical mean and ±3sigma is evaluated only for tests with N ≥ 30pcs.
Offset drift over lifetime	Offset change in room temperature (RT) during HTOL test, offset zeroed to initial measurement, N ≥ 90pcs HTOL: 1000 hours of high temperature operating life at +125°C, VDD=3.6V.
Offset drift over temperature	Offset drift over temperature is determined by ((maximum offset over temperature) - (minimum offset over temperature)) / 2 in condition of one temperature sweep in specified temperature range.
Sensitivity	Sensitivity is defined as $Sensitivity = \frac{ACC_{meas}(a_{+1g}) - ACC_{meas}(a_{-1g})}{a_{+1g} - a_{-1g}}$ Where a_{+1g}=applied acceleration at +1g (i.e. +1g gravity of manufacturing location) a_{-1g}=applied acceleration at -1g (i.e. -1g gravity of manufacturing location) $ACC_{meas}(a_n)$=measured acceleration at a_n [LSB]
Total sensitivity error	Includes sensitivity error from calibration, temperature, supply voltage and drift over lifetime. Lifetime tests listed in total offset error.
Linearity error	Linearity is the maximum deviation from the straight line defined by the measured values at the operating range end points.
Cross-Axis sensitivity	Cross-axis sensitivity is the maximum sensitivity in the plane perpendicular to the measuring direction relative to the sensitivity in the measuring direction. $Cross - axis\_sensitivity = \frac{ACC_{meas} - ACC_{meas}}{2 \times Sensitivit} \times 100\%$ Where ACC_{meas}= measured acceleration in 0g position perpendicular to the measuring direction

2.5 Gyro typical performance characteristics for SCC400T series

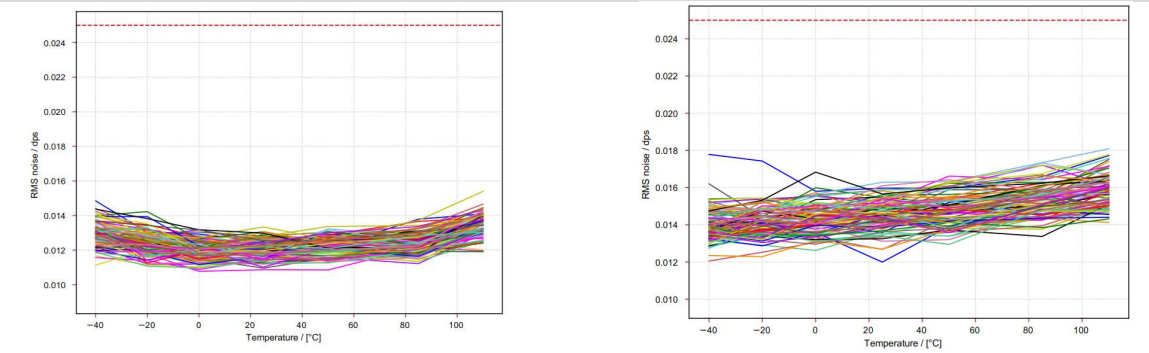
X-Gyro **Z-Gyro**



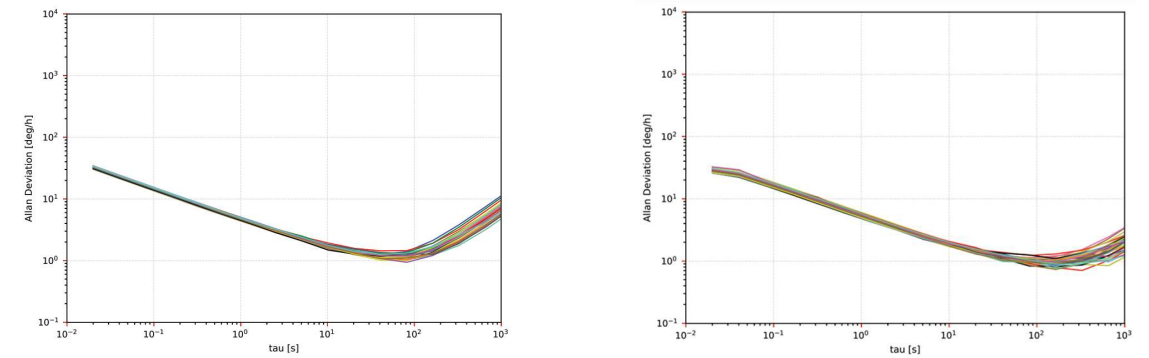
Offset drift over temperature from room temperature (°/s)



Sensitivity drift over temperature from room temperature (%)



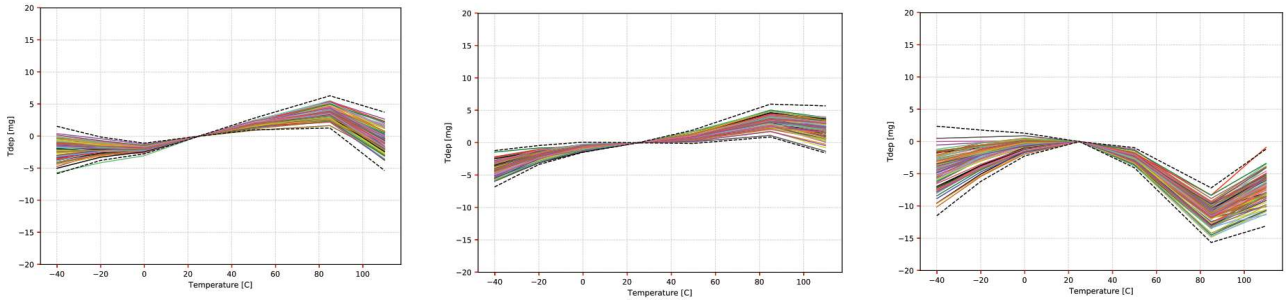
RMS noise 46Hz LPF (°/sRMS)



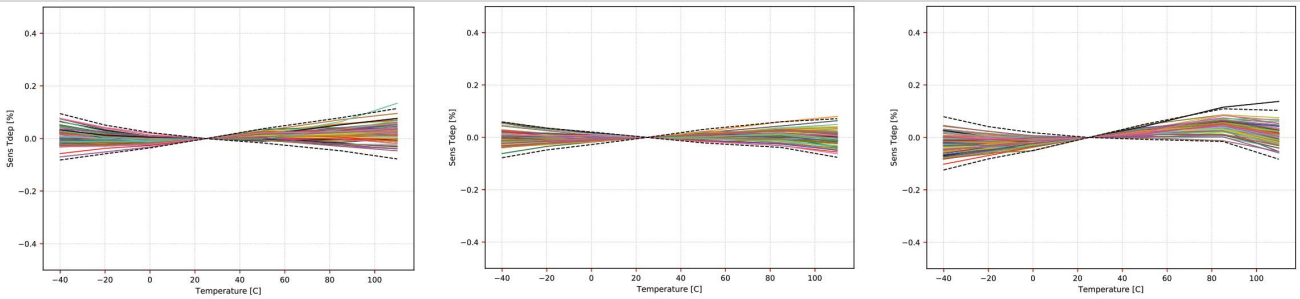
Allan variance

2.6 Accelerometer typical performance characteristics for SCC433T-K03 series

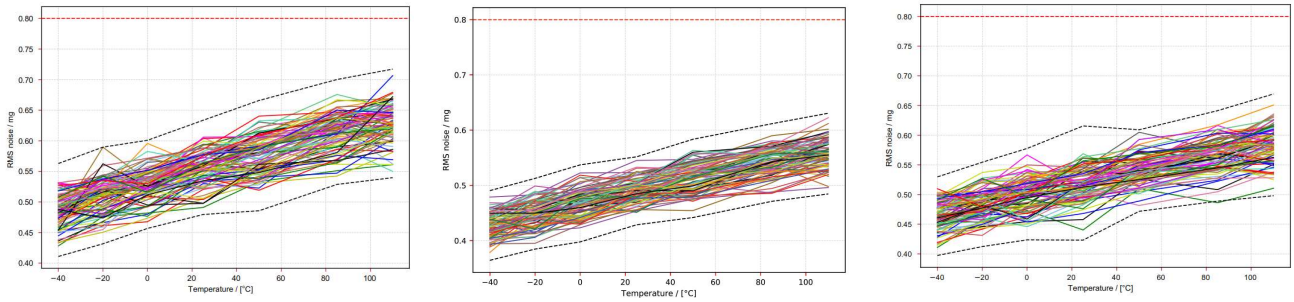
ACC_X	ACC_Y	ACC_Z



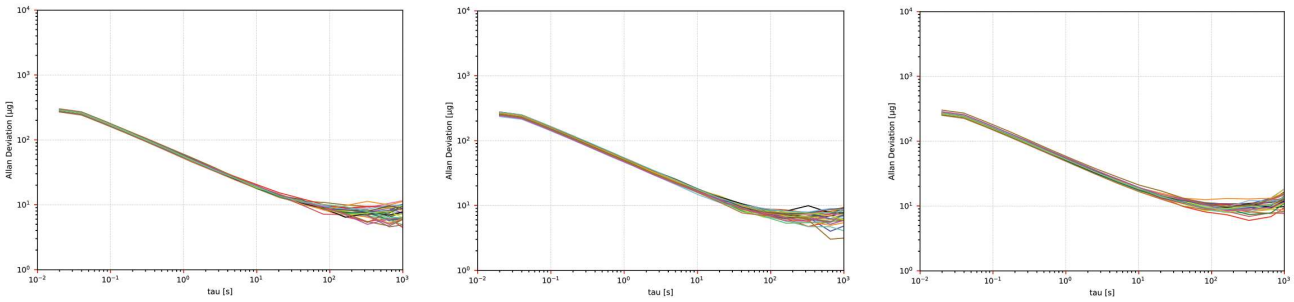
Offset drift over temperature from room temperature (mg)



Sensitivity drift over temperature from room temperature (%)



RMS noise 46Hz LPF (mgRMS)



Allan variance

2.7 General Specifications

General specifications for SCC400T series component are presented in Table 7. All analog voltages are related to the potential at GNDA and all digital voltages are related to the potential at GNDD.

Table 7. General specifications.

Parameter	Condition		CC/ SC	Unit	Min	Typ	Max
Supply voltage: V3p3A	Analog supply Voltage			V	3.0	3.3	3.6
Supply voltage: V3p3D	Digital supply voltage			V	3.0	3.3	3.6
Total current, I_TOTAL	Total current consumption during normal operation mode I_TOTAL= Analog + Digital supply current	1DOF	CC	mA		12	19
		5DOF	CC	mA		19	25
Total current, I_TOTAL	In lower power mode (Before operation mode on)			mA		3	5
Total current reset	Total average current during reset			mA			2
POR_TH_H	Threshold of Power On Reset (POR) for rising V3p3A, V3p3D			V	2.7	2.8	2.9
POR_TH_L	Threshold of Power On Reset (POR) for falling V3p3A, V3p3D			V	2.5	2.6	2.8
TRESD_r	Time to reset delay for rising inputs Wait time that rising supply voltages and rising EXTRESN input signal (optional) are above their threshold levels.			ms	15		
TMODE	Wait time to set the operation mode after the supply in the specification. Wait time needed after power on or after reset. (Wait time starts when supply is inside spec limits.) SPI is not functional during this time.			ms	25		
TRES_SPI	Time to reset SPI : Wait time after reset. CSB shall be high.			ms	2		

2.8 Performance Specification for Temperature Sensor

Table 8. Temperature sensor performance specifications.

Parameter	Condition	Min.	Typ	Max.	Unit
Temperature signal range		-50		+149	°C
Temperature signal sensitivity			30		LSB/°C
Offset error		-15		+15	°C
Sensitivity error		-10		+10	%
Linearity error			±3		%

Temperature is converted to °C with following equation: Temperature [°C] = 25 + (TEMP / 30) where TEMP is temperature sensor output register content in decimal format (2's complement).

2.9 Absolute Maximum Ratings

Within the maximum ratings (Table 9. Absolute maximum ratings.) in an instant, no damage to the component shall occur. Parametric values may deviate from specification, yet no functional deviation shall occur. All analog voltages are related to the potential at GNDA, all digital voltages are related to GNDD.

Table 9. Absolute maximum ratings.

Parameter	Remark	Min.	Recommended	Max.	Unit
SUPPLY	Supply voltage (pins V3p3A, V3p3D)	-0.3		4.3	V
AIN/AOUT	Voltage at analog input and output pins	-0.3		SUPPLY+0.3 ≤4.3	V
DIN/DOUT	Voltage at digital input and output pins	-0.3		SUPPLY+0.3 ≤4.3	V
Tstg	Storage temperature range A)	-50		140	°C
ESD_HBM	ESD according Human Body Model (HBM), Q100-002	-2000		2000	V
ESD_MM	ESD according Machine Model (MM), Q100-003	-200		200	V
ESD_CDM	ESD according Charged Device Model (CDM), Q100-011	-500 -750 (corner pins)		500 750 (corner pins)	V
-	Max peak body temperature during reflow B)			260	°C
-	Maximum storage time before soldering		1	2	years
US	Ultrasonic agitation (cleaning, welding, etc)	Prohibited			

A) No damage to the component shall occur within the maximum ratings in an instant and also max 24hour,

B) Maximum allowable time within 260°C +0°C/-5°C = 30s.

2.10 Pin Description

The pinout for SCC400T is presented in Figure 1, while the pin descriptions can be found in Table 10.

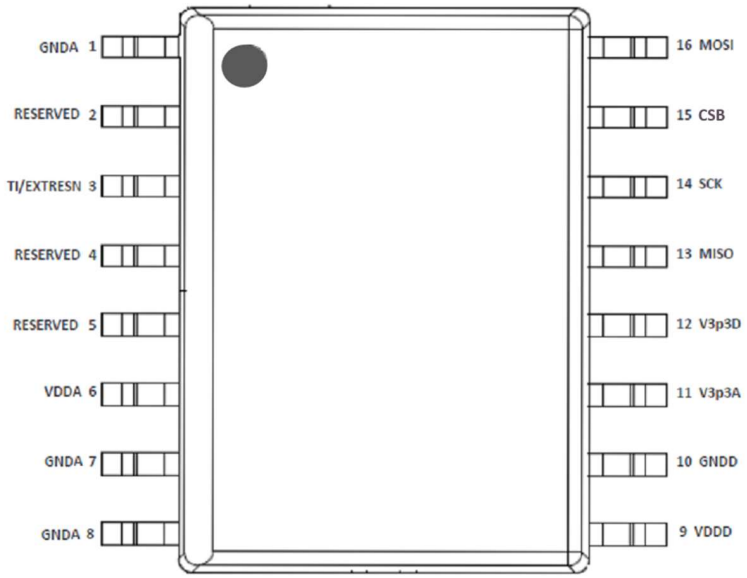


Figure 1. Pinout for SCC400T.

Table 10. SCC400T pin descriptions.

Pin#	Name	Type	Description
1	GNDA	GND	EMC protection and ground
2	RESERVED	-	Factory use only, connect to GND
3	TI/EXTRESN	DIN	Optional external Reset, 3.3V logic compatible Schmitt-trigger input with internal pull-up, LOW-HIGH transition causes system restart. Minimum low time 100us.
4	RESERVED	-	Factory use only, connect to GND
5	RESERVED	-	Factory use only, connect to GND
6	VDDA	AOUT	Regulated supply for analog core. Use external capacitor which is connected according to the diagram in Figure 18.
7	GNDA	GND	Analog Supply return (ground), connect externally to GND
8	GNDA	GND	Analog Supply return (ground), connect externally to GND
9	VDDD	AOUT	Regulated supply for digital core. Use external capacitor which is connected according to the diagram in Figure 18.
10	GNDD	GND	Digital Supply return (ground), connect externally to GND
11	V3p3A	SUPPLY	Analog Supply voltage
12	V3p3D	SUPPLY	Digital Supply voltage
13	MISO	DOUT	Data Out of SPI Interface
14	SCK	DIN	Clock Signal of SPI Interface
15	CSB	DIN	Chip Selected of SPI Interface
16	MOSI	DIN	Data In of SPI Interface

2.11 Digital I/O Specification

Table 11 describes the DC characteristics of SCC400T sensor SPI I/O pins. Supply voltage is 3.3 V unless otherwise specified. Current flowing into the circuit has a positive value.

Table 11. SPI DC characteristics.

Symbol	Description	Min.	Nom.	Max.	Unit
Serial Clock SCLK					
VinHigh	Input high voltage	2		V3p3D+0.3	V
VinLow	Input low voltage	-0.3		0.8	V
Vhy	Input hysteresis	0.2			V
Isource	Input current source (Pull down) , Vin = DVDD	24		36	uA
Cin	Input capacitance			6	pF
Chip select CSB (Pull Up), low active					
VinHigh	Input high voltage	2		V3p3D+0.3	V
VinLow	Input low voltage	-0.3		0.8	V
Vhy	Input hysteresis	0.2			V
Isource	Input current source (Pull Up), Vin = 0V	24		36	uA
Cin	Input capacitance			6	pF
Vin_open	Open circuit output voltage	2			V
Serial data input MOSI (Pull Down)					
VinHigh	Input high voltage	2		V3p3D+0.3	V
VinLow	Input low voltage	-0.3		0.8	V
Vhy	Input hysteresis	0.2			V
Isource	Input current source (Pull Up), Vin = DVDD	24		36	uA
Cin	Input capacitance			6	pF
Vin_open	Open circuit output voltage			0.3	V
Serial data output MISO (Tri state)					
VoutHigh_-1mA	Output high voltage, Iout = -1mA	V3p3D-0.5			V
VinHigh_1mA	Output low voltage, Iout = +1mA			0.5	V
Iout_Hz	High impedance output current, 0V < VMISO < V3p3D	-1		1	uA
Cld_miso	Capacitive load. The slope of the MISO output signal can be controlled to meet EMI requirements under specified load conditions.			160	pF

Table 12. EXTRESN pin characteristics

Symbol	Description	Min.	Nom.	Max.	Unit
Digital pin EXTRESN					
VinHigh	Input high voltage	2		V3p3A+0.3	V
VinLow	Input low voltage	-0.3		0.8	V
Vhy	Input hysteresis	0.2			V
Isource	Start-up indication phase inactive Start-up indication phase active	60 30		160 80	µA µA

2.12 SPI AC Characteristics

The AC characteristics of SCC400T are defined in Figure 2 and Table 13.

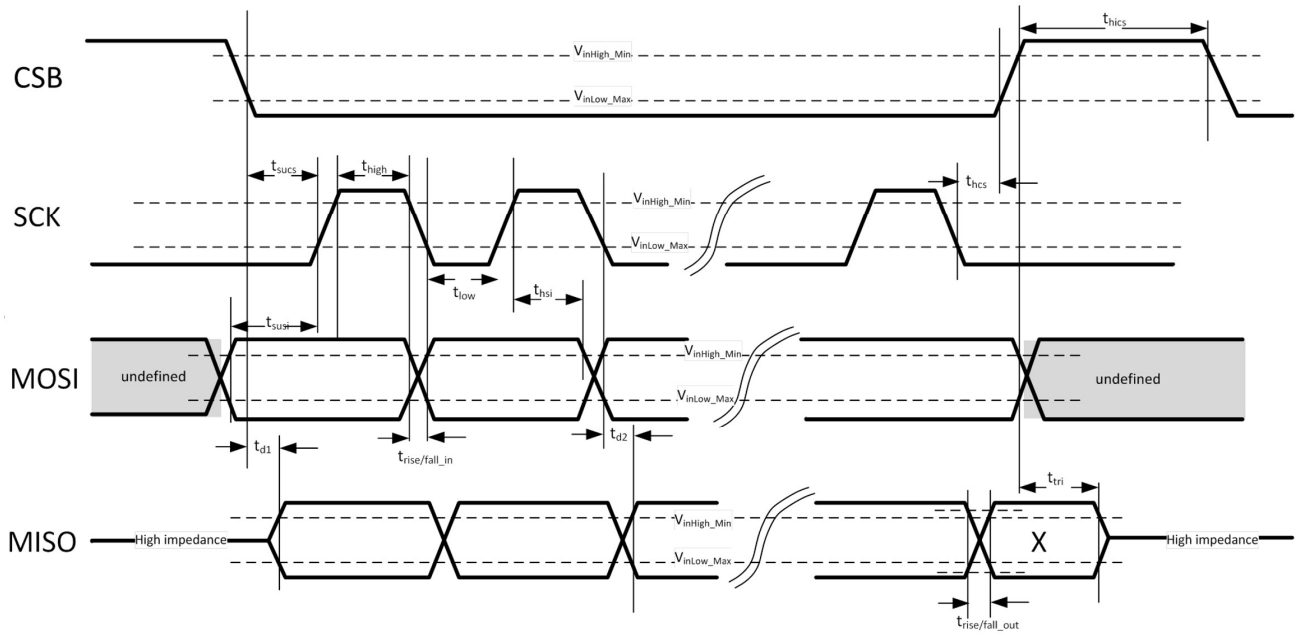


Figure 2. Timing diagram of SPI communication.

Table 13. SPI AC electrical characteristics.

Symbol	Description	Min.	Nom.	Max.	Unit
f_{SPI}	Master (MCU): SPI SCLK frequency	0.1	-	10	MHz
t_{SPI}	Master (MCU): SPI SCLK period	-	1/ f_{SPI}	-	-
t_{high}	Master (MCU): High time: duration of logical high level at SCLK (from V_{inHigh_min} to V_{inHigh_min})	35	$t_{SPI}/2$	-	ns
t_{low}	Master (MCU): Low time: duration of logical low level at SCLK (from V_{inLow_max} to V_{inLow_max})	35	$t_{SPI}/2$	-	ns
t_{sucs}	Master (MCU): Setup time CSB: time between the falling edge of CSB and the rising edge of SCLK (from V_{inLow_max} to V_{inLow_max})	40	$t_{SPI}/2$	-	ns
t_{susi}	Master (MCU): Setup time at MOSI: setup time of MOSI before the rising edge of SCLK (from V_{inLow_max} to V_{inLow_max} or from V_{inHigh_min} to V_{inLow_max})	10	-	-	ns
t_{hsi}	Master(MCU): Hold time at MOSI: hold time of MOSI after rising edge of SCLK (from V_{inHigh_min} to V_{inLow_max} or to V_{inHigh_min})	20	-	-	ns
t_{hcs}	Master (MCU): Hold time of CSB: time between the falling edge of SCLK and the rising edge of CSB (from V_{inLow_max} to V_{inLow_max})	30	$t_{SPI}/2$	-	ns

t_{hics}	Master (MCU): Minimum high time of CSB between two consecutive transfers (from V_{inHigh_min} to V_{inHigh_min})	30	$t_{SPI}/2$		ns
$t_{rise/fall\_in}$	Master (MCU): Rise/fall time of SCK/MOSI signals (from V_{inLow_max} to V_{inHigh_min} or from V_{inHigh_min} to V_{inLow_max})	-	-	0.15x t_{SPI}	ns
t_{d1}	Slave(=SCC400T ASIC): Delay time: time delay from the falling edge of CSB totab data valid at MISO (from V_{inLow_max} to V_{InLow_max} or to V_{InHigh_min})	-	-	30	ns
t_{d2}	Slave(=SCC400T ASIC): Delay time: time delay from falling edge of SCLK to data valid at MISO (from V_{inLow_max} to V_{InLow_max} or to V_{InHigh_min})	0	-	30	ns
t_{tri}	Slave(=SCC400T ASIC): Tri-state delay time: time between the rising edge of CSB to MISO in Tri-state (from V_{inHigh_min} to X)	-	-	25	ns
$t_{rise/fall\_out}$	Slave(=SCC400T ASIC): Rise/fall time of MISO signal ($V_{Out\_10\%}$ to $V_{Out\_90\%}$ and from $V_{Out\_90\%}$ to $V_{Out\_10\%}$) User selectable MISO slew rate control in Mode register (19h)	4	10	16	ns

2.13 Measurement Axis and Directions

Rx (1DOF) Rx-Rz-Ax-Ay-Az (5DOF)

Figure 3. SCC400T series measurement directions.

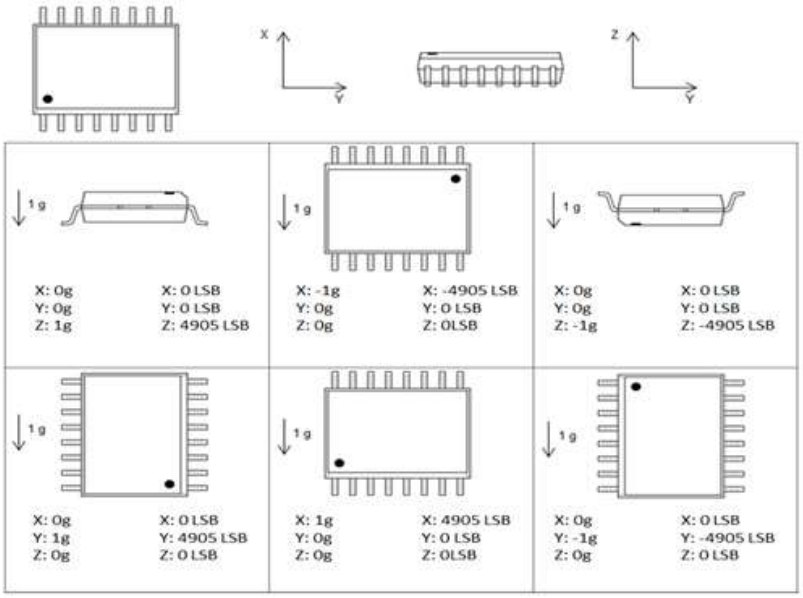


Figure 4 Accelerometer measurement directions and outputs (1g resolution depends on output channel).

2.14 Packing Characteristics

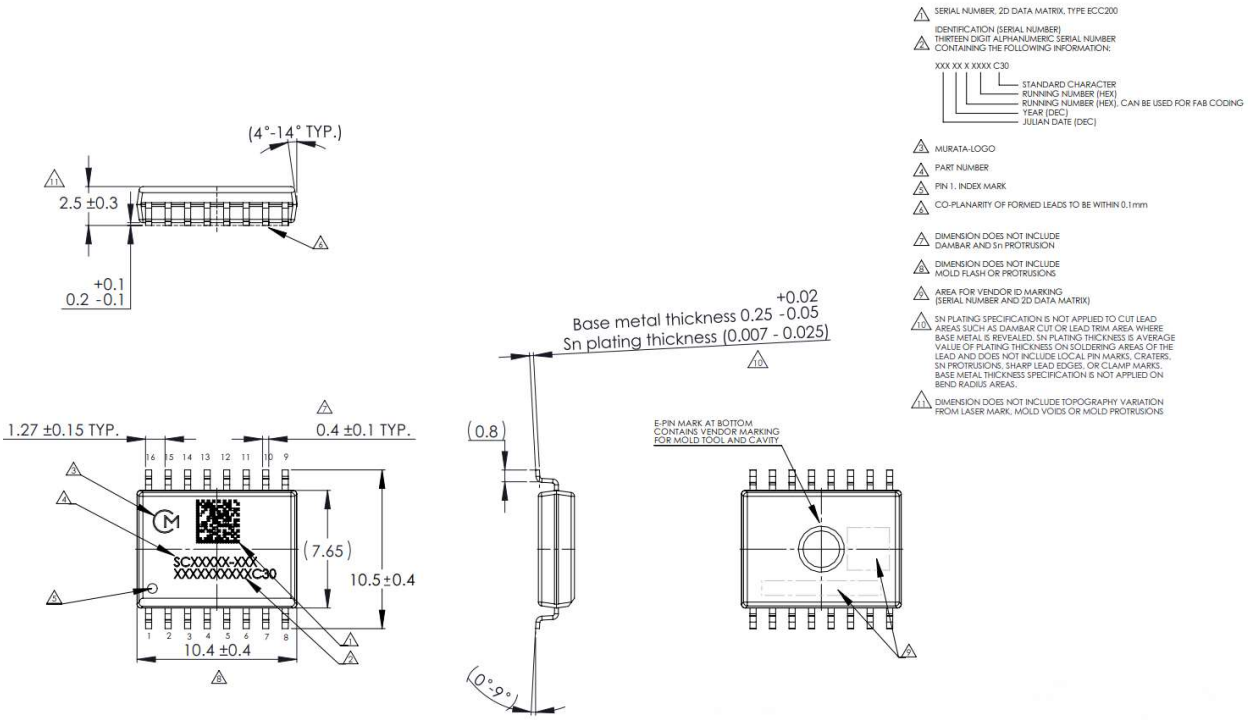


Figure 5. The outline of the SCC400T package (SOIC16-W) in mm.

2.15 PCB Footprint

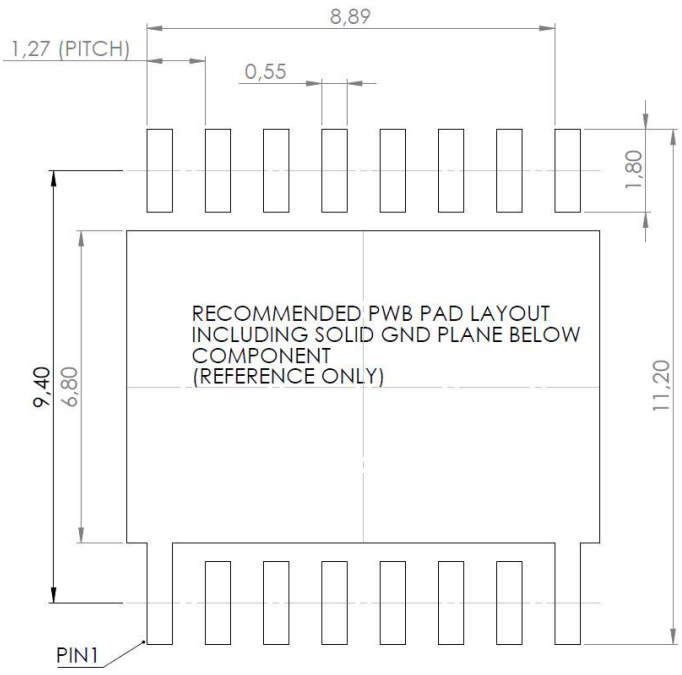


Figure 6. Recommended PWB pad layout for SCC400T.

For application schematic and PCB layout, please refer to chapter 9 Application information.

3 Assembly Instructions

The design of the application PCB, design of fixtures, conformal coating, vibration and mechanical shocks, material selections, application environment and component assembly process can have an impact on the sensor performance. Please refer to the document “APP 10207 Assembly instructions for SCC400T Series ENG” for related details.

4 Order codes

SCC433T-K03 order codes.

Order code	Description	Packing	Qty
SCC433T-K03-004	Combined gyro (X/Z-axis ±300°/s) and accelerometer (XYZ-axis ±6g & 8g) with SPI interface	bulk	4 pcs
SCC433T-K03-05		T&R	50 pcs
SCC433T-K03-10		T&R	1000 pcs

SCR410T-K03 order codes.

Order code	Description	Packing	Qty
SCR410T-K03-004	Gyro (X-axis ±300°/s) with SPI interface	bulk	4 pcs
SCR410T-K03-05		T&R	50 pcs
SCR410T-K03-10		T&R	1000 pcs

This is the end of publicly available document. For full version of this of this data sheet and assembly instructions, please contact Murata.