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Supersedes:

UTS-G USER MANUAL

Universal Tilt Sensor with Gyroscope

ENGINEERING YOUR SUCCESS.

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Publication History

The following table provides an overview of the changes made to this document over the course of its publication history

Revision	Description of Change
Rev. 001	First release of this document
Rev. 002	Update Table 6.6:1: Data Broadcast Messages

Table of Contents

Table of Figures

Table of Tables

1 Safety

Do not perform the procedures in this manual unless you are experienced in the handling of electronic equipment.

Contact the manufacturer if there is anything you are not sure about or if you have any questions regarding the product and its handling or maintenance.

The term "manufacturer" refers to Parker Hannifin Corporation.

Safety Symbols

The following symbols are used in this document to indicate potentially hazardous situations:

- *Danger! Risk of death or injury.*
- *Warning! Risk of damage to equipment or degradation of signal.*

When you see these symbols, follow the instructions carefully and proceed with caution.

General Safety Regulations

Work on the hydraulics control electronics may only be carried out by trained personnel who are well-acquainted with the control system, the machine, and its safety regulations.

- Follow the manufacturer's regulations when mounting, modifying, repairing, and maintaining equipment. The manufacturer assumes no responsibility for any accidents caused by incorrectly mounted or incorrectly maintained equipment. The manufacturer assumes no responsibility for the system being incorrectly applied, or the system being programmed in a manner that jeopardizes safety.
- Do not use the product if electronic modules, cabling, or connectors are damaged or if the control system shows error functions.
- Electronic control systems in an inappropriate installation and in combination with strong electromagnetic interference fields can, in extreme cases, cause an unintentional change of speed of the output function
- This product can expose you to chemicals including **ANTIMONY TRIOXIDE,CARBON BLACK (AIRBORNE, UNBOUND PARTICLES OF RESPIRABLE SIZE)** which is known to the State of California to cause cancer and **4,4'-(PROPANE-2,2-DIYL)DIPHENOL, BPA, P,P'-ISOPROPYLIDENEBISPHENOL,** which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Welding After Installation

If welding is required for installation, complete as much as possible of the welding work before the installation of the system. If welding must be done afterwards, proceed as follows:

- Do not place the welding unit cables near the electrical wires of the control system
- If sensor has been installed and additional welding is required, remove the 4-pin connector from the sensor to avoid possible electrical damage to sensor

1. Disconnect the electrical connections between the system and external equipment
2. Disconnect the negative cable from the battery
3. Disconnect the positive cable from the battery
4. Connect the welder's ground wire as close as possible to the place of the welding

Construction Regulations

The vehicle must be equipped with an emergency stop which disconnects the supply voltage to the control system's electrical units. The emergency stop must be easily accessible to the operator. If possible, the machine must be built so that the supply voltage to the control system's electrical units is disconnected when the operator leaves the operator's station.

Safety During Installation

- Incorrectly positioned or mounted cabling can be influenced by radio signals, which can interfere with the functions of the system.

Safety During Start-Up

- *Danger! Risk of death or injury.* Do not start the machine's engine before the control system is mounted and its electrical functions have been verified.

  Do not start the machine if anyone is near the machine.

Safety During Maintenance and Fault Diagnosis

Before performing any work on the hydraulics control electronics, ensure that

- The machine cannot start moving
- Functions are positioned safely
- The machine is turned off
- The hydraulic system is relieved from any pressure
- Supply voltage to the control electronics is disconnected

2 Document Introduction

2.1 Scope

The purpose of this document is to detail performance characteristics, installation recommendations, and define CAN messages for the Universal Tilt Sensor with Gyroscope (UTS-G) products. These instructions/guidelines are to be used as a reference tool for the manufacturer's design, production, and service personnel. The user of this manual should have basic knowledge in the handling of electronic equipment.

2.2 Terminology

The abbreviations and acronyms used in this manual are defined in the following table.

Table 2.2:1: Abbreviation List

Abbreviation	Explanation
UTS-G	Universal Tilt Sensor with Gyroscope
CAN	Controller Area Network
EMI	Electromagnetic Interference
SAE	Society of Automotive Engineers
PGN	Parameter Group Number
MEMS	Micro Electro-Mechanical Systems
SSI2	Slope Sensor Information Type 2
JTAG	Joint (European) Test Access Group – type of connector

3 Datasheet

3.1 UTS-G Characteristics

Table 3.1:1: UTS-G Physical and Electrical Characteristics

UTS-G Physical and Electrical Characteristics	
General	
Weight	0.14 kg
Temperature (operating)	-40 °C to 85 °C
Temperature (storage)	-40 °C to 105 °C
Number of axes	3 (X/Y/X) , 2 (SSI2)
Tilt range[1]	± 90°
Angular Rate	± 180° Roll, ± 90° Pitch
Material Characteristics	
Mounting	Tripod
Mounting bolt	¼”-20 UNC or M6x1.0
Mounting torque	135 in-lb max
Mounting surface flatness	0.010 in
Connector	Deutsch DT
Communication	
CAN protocol	SAE J1939
CAN messages	See section 7
CAN bus speed	250 kbps, up to 500kbps
Data broadcast rate	50 Hz, up to 200 Hz
CAN source address	0xE4
Electrical Specifications	
Operating voltage	6.0 - 36 V_{DC}(1)
Overvoltage	48 V_{DC}
Reverse polarity	- 48 V_{DC}
Short circuit protection	-V_{BAT} and +48 V_{DC}
Current draw	23.0 mA (12 V) 19 mA (24 V)

[1]Regulated voltage is required for a 12.0 V_{DC} system. Required startup voltage must be at least 5.25 Vdc up to 20 ms MAX.

3.2 UTS-G Capabilities

Table 3.2:1: UTS-G Capabilities

UTS-G Capabilities	
Static Motion	
Tilt Range (X,Y,Z)	± 90°
Inclination Error (25°C)	± 0.3°
Dynamic Motion	
Range	
Roll	± 180°
Pitch	± 90°
Translational and Rectilinear Acceleration Error	
X	± 0.5°
Y	± 0.5°
Z	± 0.5°
Pitch	± 0.5°
Roll	± 0.5°
Dynamic inclination error < 100 °/s	± 0.5°
Time Delay (100 DPS)	10 ms
General	
Pitch & Roll Resolution	0.00003°/ BIT
Tilt Resolution	0.01°/ BIT
Repeatability	± 0.05°
Supported Conventions[(2)]	J1939DA-SSI2, UTS-G
Output PGNs[(3)]	0xF029, 0xFFAB
Temp. Range	-40°C - 85°C
Startup Time	50 ms Max
Settling Time	100 ms
Variance from Temperature	± 0.003°/°C * [1 + 10 cos(z)] * |t – 25|°C
	z = angle of Z Axis, t = temperature
Software Features	
Application Software Update	CAN-J1939

[2]SSI2 defined by J1939-DA.

[3]The UTS-G utilizes a proprietary message format noted in Table 4: Data Broadcast Messages. It is supported by the UTS-G to provide Tilt information.

3.3 UTS-G Sensor Features

Table 3.3:1: UTS-G Sensor Features

UTS-G Sensor Features	
Functionality	
Tilt and SSI2 Manual Offset Configuration	CAN-J1939
Tilt and SSI2 Auto-Offset Command	CAN-J1939
Tilt and SSI2 Message Rate Command	CAN-J1939
Source Address Command	CAN-J1939
CAN Bit Rate Command	CAN-J1939
Tilt and SSI2 Messages Command	CAN-J1939
CAN	
CAN Baud Rate Configurable (250k, 500k)	
Mechanical	
Operating Temperatures	-40°C to 85°C
Storage Temperatures	-40°C to 105°C
Shock Drop	1 m
Ingress Protection	IP68 & 69k
Performance	
Configurable Transmission Rate (Pitch / Roll)	1 – 200 Hz
Gyroscope	
3D performance	± 2000 dps
Angular Rate Resolution	0.00875 dps / bit
Rate Noise Spectral Density	0.005 dps / √Hz (typ.)
Drift	
ARW	~ 0.30 deg / √hr
BI	~ 1.30 deg / hr
Accelerometer	
Resolution	0.061 mG / bit
Noise Density	90 uG / √Hz
Drift	
VRW	~3.0 mg*s / √hr
BI	~ 80 mg*s/ hr

Table 3.3:2: UTS-G Features (continued)

UTS-G Features (continued)
Environmental
EMI
ISO 11452-2 100 V / m
ISO 7637-2, -3 Transients
ESD
ISO 10605:2008 ±15 kV
EMC
ISO 13766: 2018
EN 13309: 2010
Climate
IP68 / IP69K with rear connector protection for both
Chemical
Liquids (resistance) standard automotive
Certifications
EU RoHS 2
CE EN 61000-6-2, EN 61000-6-4, EN 13309, ISO 13766, ISO 14982
UL 94V-0

4 Product Introduction

4.1 Overview

Application

The UTS-G belongs to the Parker family of accessories provided to complement electronic control systems. The UTS-G is a multi-axis MEMS technology tilt sensor for mobile hydraulic applications. The sensor communicates over a CAN bus using SAE J1939 protocol. The UTS-G has an integrated Deutsch connector. Improving the sensor to increasing mobile equipment performance requirements for dynamic performance we have introduced gyroscopic compensation focused upon properties such as stability, reliability, electromagnetic immunity, and ease of installation.

Reliability

The UTS-G has a glass-filled, hybrid plastic construction for sturdiness and corrosion resistance. The sensor is very robust and able to withstand rugged applications. For moisture protection, the electronics are sealed against harsh environments in an enclosure by using spin-weld technology. These features give the sensor IP68 and IP69k protection for exposed outdoor applications when mounted right side up and an IP68 rating when mounted up-side down. Additionally, the UTS-G design has Automotive level EMI protection, ESD protection, and reverse polarity protection allow maximum versatility in mobile applications.

Installation

Like the UTS the UTS-G uses the same patented housing. The 3 mounting holes are in a tripod pattern to facilitate a mistake proof, poka yoke, installation reducing overall manufacturing time. These features provide for easy installation and removal, even in field conditions.

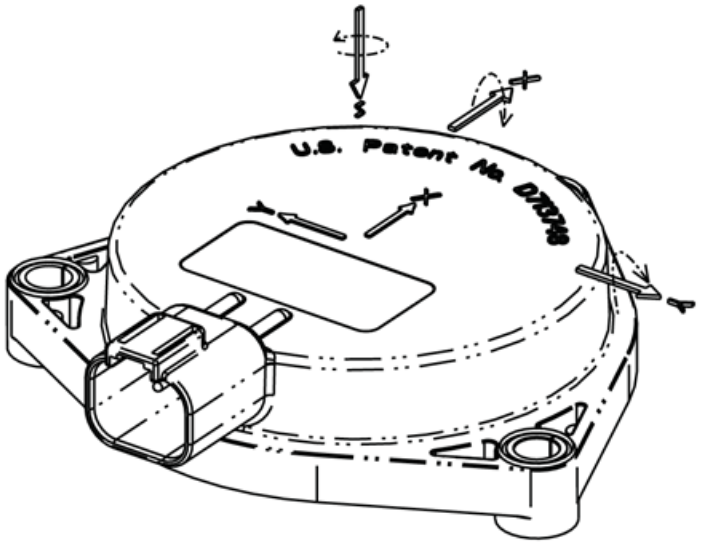

Figure 4.1.1: UTS-G with Deutsch DT04-4P Connector

4.2 Supported Angles of Motion

The UTS-G follows the UTS product family convention for output transmission of Tilt information. The UTS-G adds an additional output to support Pitch and Roll information in accordance to the J1939 SSI2 convention. Users can now monitor Pitch ± 90 ° and Roll up to ± 180° in real-time with the same precision of Tilt during dynamic motion.

The J1939 standard dictates that Euler Sequence 3-2-1 is used to calculate the Pitch and Roll. Reference the UTS-G print, *163161 CL* for the relative directions of the UTS-G with respect to the axis.

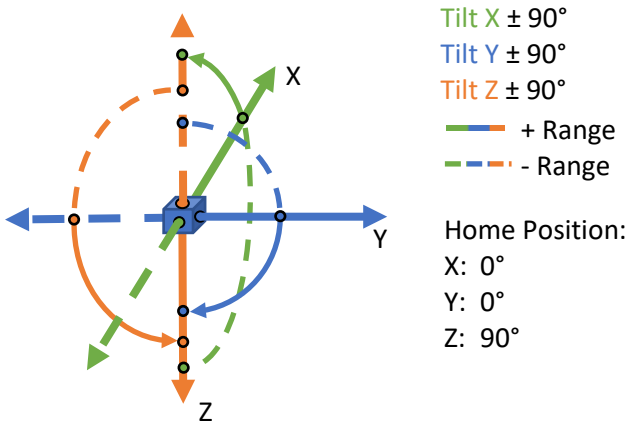

Figure 4.2.2:Supported Tilt Range

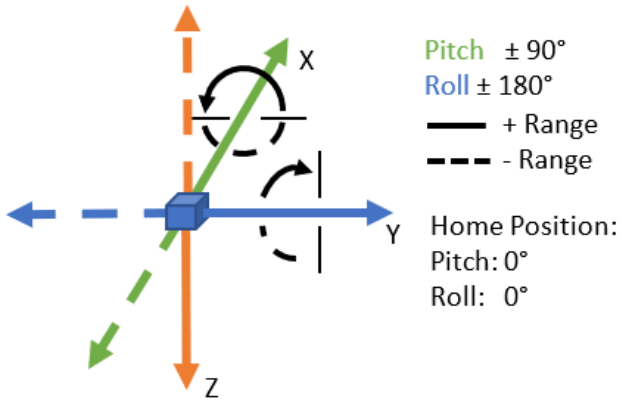

Figure 4.2.1: Supported Pitch/Roll Range

Supported Tilt Range
The range for X/Y/Z axis is ± 90°. The positive range, represented by the solid lines, and the negative range, represented by the dashed lines, highlight the range of motion that meaningful data is produced. The solid/dotted arcs show the respective hemispheres that data will be positive/negative.

The "Home Position" is the tilt output when the UTS-G is on a flat horizontal surface without motion.

Supported Pitch and Roll Range
Pitch rotates about the Y axis and has a ± 90° range. Roll rotates about the X axis, has a ± 180° range.

The "Home Position" is the pitch/roll output is on a flat horizontal surface without motion.

5 Installation Guidelines

5.1 Operating Conditions

The UTS-G should not be continuously submerged in any liquid without added protection. The operating temperatures for the sensor are -40 to +85°C.

5.2 Power Supply Requirements

Table 6.3.1 shows the power supply requirements for the UTS-G. The UTS-G operates in 12V or 24V systems and can operate from 6-36Vdc with a regulated power supply.

5.3 Connector

The UTS-G uses the Deutsch DT series connector type. Note the connector pin plating is nickel. It is recommended to use nickel plated mating connection to avoid galvanic corrosion over time.

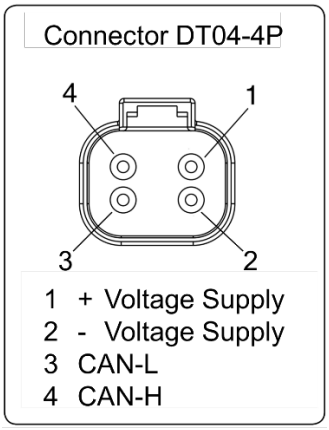

Figure 5.3.2: UTS -G Connector

Mating Connector:	DT06-4S
	W4S
	1062-16-0122

Figure 5.3.1: UTS-G Mating Connector

5.4 Mounting Requirements

Mounting Torque

It is important to tighten the mounting fasteners enough to prevent vibration and loosening. Do not exceed 135 in-lbs (15.3 Nm).

- ⚠ Do not use an impact wrench as this type of device could damage the unit.

Mounting Surface

It is important for the mounting surface to be flat, clean, and clear of any imperfections that may cause false angle readings.

- ⚠ Do not mount to metal with surface flatness greater than .010” (.254mm).
- ⚠ Avoid mounting to metal less than 1/8” (3.175mm) thick as this can cause excess vibration.

Mounting Orientation

Mounting orientation is not critical to the function of the UTS-G.

5.5 Installation Validation

Due to manufacturing tolerances, evaluation is required to verify the output signal is of acceptable quality after the sensor is properly mounted. If the device is not level after installation, coordinate offsets can be made to account for this. Refer to Section 8.3 for an example on how to adjust offsets.

6 CAN Information

6.1 SAE J1939

The J1939 standards come from the international Society of Automotive Engineers (SAE) and were developed to provide a standard architecture by which multiple electronic systems on a vehicle can communicate. J1939 has been implemented in a broad range of vehicles and transportation systems and provides a reliable communication protocol over a high-speed CAN network.

The UTS-G uses this protocol to transmit its condition as a predefined set of outputs. All messages are SAE J1939 Proprietary B PGN's except the address claim request and response.

6.2 Network Compatibility

The UTS-G is compatible with 250 kbps or 500kbps CAN baud rates, qualifying it as a “High-Speed” CAN sensor. Per ISO 11898-2, the linear bus must be terminated with two 120 Ω resistors at the ends of the transmission lines. External CAN termination is required and not provided with the UTS-G product. Follow SAE J1939 standards when creating the harness connected to the sensor.

6.3 Identifier Description

The J1939 protocol uses a 29-bit identifier. The 29-bit identifier is built up as follows:

- Bit 0-7 is Source Address (**SA**)
- Bit 8-23 is Parameter Group Number (**PGN**)
- Bit 24 is Data Page (**DP**)
- Bit 25 is Reserved (**R**)
- Bit 26-28 is Priority (**P**)

Each identifier has an associated 8-byte data field. The data field is built up as shown in Table 7.3.2.

Table 6.3:1: J1939 CAN Identifier Structure

	29-bit IDENTIFIER																											
	Priority			**R**	**DP**	**P**arameter **G**roup **N**umber														**S**ource **A**ddress							
						PDU Format								PDU Specific														
CAN 29 Bit ID Position	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

6.4 Data field structure

The Data Field is structured as Little Endian within the bytes, and Big Endian for the Data Field.

Table 6.4:1: The Data Field Structure

DATA FIELD																													
BYTE 1								BYTE 2								BYTE 3-7						BYTE 8							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	…		1	0	7	6	5	4	3	2	1	0

6.5 UTS-G Communications

The UTS-G uses two communication message types: Global and Specific Address.

- **Global Message:** This is the operational “Broadcast mode” message for all the axis tilt information and pitch and roll information on the sensor. In these messages the unit broadcasts the outgoing data on the J1939 at 20mSec intervals.
- **Specific Address Message:** This is the “Command mode” message for the sensor. In these messages the UTS-G receives write and query messages to its node address from the J1939 bus.
    - ⚠ Ensure there is no loss of power while making programming changes with the UTS-G in service mode

6.6 Data Broadcast Messages

The global messages below are enabled by default. The core messages of Pitch/Roll and Tilt information will be found in these data frames.

Adjustable Parameters

- Source Address PGN and Broadcast rate are configurable.
    - See Table 6.10.1 - Group 0, Parameter number 16,17.
- Pitch/Roll data frame, Tilt data frame (X/Y/Z), Pitch/Roll Frame Enable, and Tilt Frame Enable are also configurable.
    - See Table 6.10.2 - Group 2, Parameter number 1,3, 13, 14
- Pitch/Roll offset and Tilt Offset are also configurable
    - See Table 6.10.2 – Group 2, Parameter number 18, 19, 20, 21, 22.

Table 6.6:1: Data Broadcast Messages

Data Broadcast messages							
Pitch/Roll Data Frame							Default Status: Enabled
Default PGN **0xF029** (61481)		PF **240**	PS **41**	SA **SA**	Parameter Group Definition **Proprietary B**	Default Priority **6**	Default Broadcast Interval **20 ms**
Data Byte	Length	Parameter Name (Extended Range)			Format	Resolution	Offset	Description
1	3 bytes	Pitch Angle			Unsigned Integer	1/32768° per bit	-250°	Calculated Pitch Angle
4	3 bytes	Roll Angle			Unsigned Integer	1/32768° per bit	-250°	Calculated Roll Angle
7.1	2 bits	Unused			-	-	0	0xFF
7.3	2 bits	Unused			-	-	0	0xFF
7.5	2 bits	Unused			-	-	0	0xFF
7.7	2 bits	Unused			-	-	0	0xFF
8	1 byte	Unused			ms	0.5 ms/bit	0	0xFF
Tilt Output Data Frame							Default Status: Enabled
Default PGN **0xFFAB** (65451)		PF **255**	PS **171**	SA **SA**	Parameter Group Definition **Proprietary B**	Default Priority **6**	Default Broadcast Interval **20 ms**
Data Byte	Length	Parameter Name			Format	Resolution		Description
1	2 bytes	X Axis Tilt			16-bit Signed Int, °	0.006° per bit	0°	X-Tilt Information
3	2 bytes	Y Axis Tilt			16-bit Signed Int, °	0.006° per bit	0°	Y-Tilt Information
5	2 bytes	Z Axis Tilt			16-bit Signed Int, °	0.006° per bit	0°	Z-Tilt Information
7	1 byte	Unused			-	-	-	0xFF
8	1 byte	SW Version Type			ASCII Char	-	-	‘B’

6.7 Standard Messages Received by UTS-G

The request message may be sent to a specific address (0-253) or the global destination address (255).

The UTS-G will respond to a request message for Address Claimed (directed to its Source Address or the global address) with a successful Address Claimed (AC) message before resuming other transmissions; otherwise, the Cannot Claim Address message will be sent and the UTS-G will remain silent.

The Commanded Address message is sent using the J1939 transport protocol BAM.

The UTS-G will respond to a Commanded Address message containing its NAME with a successful Address Claimed (AC) message before resuming other transmissions; otherwise, the UTS-G will retain its previous Source Address

Table 6.7:1: SAE J1939 Standard Messages Received by UTS-G

SAE J1939 Standard Messages Received by UTS-G						
Request Message (PGN 59904) for Address Claimed (PGN 60928 - AC)						
PGN		PF	PS	SA	Parameter Group Definition	
0xEA00 (59904)		**234**	**DA**	**SA**	**PDU1 Format**	
Data Byte	Length	Parameter Name			Format	
1	1 byte	PGN (PS)			0x00	
2	1 byte	PGN (PF)			0xEE	PGN 60928 (0x00EE00)
3	1 byte	PGN (MSB)			0x00	
Commanded Address – CA						
PGN		PF	PS	SA	Parameter Group Definition	
0xFED8 (65240)		**254**	**216**	**SA**	**PDU2 Format**	
Data Byte	Length	Parameter Name			Format	
1 9	8 bytes 1 byte	NAME Address Assignment			SPN 2849, NAME of component to receive the CA message SPN 2847, valid range: 0 to 253, new Source Address of the component receiving the CA message	

6.8 Standard Messages Transmitted by UTS-G

Upon power-up, only the Cannot Claim Address message can be transmitted until an address is successfully claimed with the Address Claimed message. The Cannot Claim Message is transmitted once at startup and the Address Claimed Message is transmitted once at startup and on request.

Figure 6.8.1: SAE J1939 Standard Messages Transmitted by UTS-G

SAE J1939 Standard Messages Transmitted by UTS-G					
Address Claimed – AC					
PGN		PF	PS	SA	Parameter Group Definition
0xEE00 (60928)		**238**	**255**	**SA**	**PDU1 Format**
Data Byte	Length	Parameter Name			Format
1	21 bits	Identity Number			SPN 2837, Manufacturer serial number, set in Group 0 parameter number 18 in Table 5
3.6	11 bits	Manufacturer Code			SPN 2838, 71 – Vansco, cannot be changed
5.1	3 bits	ECU Instance			SPN 2840, set in Group 0, parameter number 19 in Table 5
5.4	5 bits	Function Instance			SPN 2839, set in Group 0, parameter number 20 in Table 5
6	1 byte	Function			SPN 2841, UTS-G function for industry group and vehicle system set in Group 0 parameter number 21 in Table 5
7.1	1 bit	Reserved			
7.2	7 bits	Vehicle System			SPN 2842, set in Group 0, parameter number 22 in Table 5
8.1	4 bits	Vehicle System Instance			SPN 2843, set in Group 0, parameter number 23 in Table 5
8.5	3 bits	Industry Group			SPN 2846, set in Group 0, parameter number 24 in Table 5
8.8	1 bit	Arbitrary Address Capable			SPN 2844, 0 – UTS-G is not set to perform Address Arbitration, cannot be changed
Cannot Claim Address					
PGN		PF	PS	SA	Parameter Group Definition
0xEE00 (60928)		**238**	**255**	**254**	**PDU1 Format**
Data Byte	Length	Parameter Name			Format
1	21 bits	Identity Number			SPN 2837, Manufacturer serial number, set in Group 0 parameter number 18 in Table 5
3.6	11 bits	Manufacturer Code			SPN 2838, 71 – Vansco, cannot be changed
5.1	3 bits	ECU Instance			SPN 2840, set in Group 0, parameter number 19 in Table 5
5.4	5 bits	Function Instance			SPN 2839, set in Group 0, parameter number 20 in Table 5
6	1 byte	Function			SPN 2841, UTS-G function for industry group and vehicle system set in Group 0 parameter number 21 in Table 5
7.1	1 bit	Reserved			
7.2	7 bits	Vehicle System			SPN 2842, set in Group 0, parameter number 22 in Table 5
8.1	4 bits	Vehicle System Instance			SPN 2843, set in Group 0, parameter number 23 in Table 5
8.5	3 bits	Industry Group			SPN 2846, set in Group 0, parameter number 24 in Table 5
8.8	1 bit	Arbitrary Address Capable			SPN 2844, 0 – UTS-G is not set to perform Address Arbitration, cannot be changed

6.9 Configuration Messages

The configuration Request Message is received by the UTS-G for reading and changing configuration parameters. These parameters would affect the data within Broadcast Messages of Table 6.7.1.

- The message is determined using the first two bytes with a PGN of 0xEF00.

The Configuration Response Message is transmitted in response to a read/write request.

- Pay attention to Data Byte 2 for the type of confirmation response.

Table 6.9:1: Configuration Messages

Configuration Messages					
Configuration Request Message					
PGN		PF	PS	SA	Parameter Group Definition
0xEF00 (61184)		**239**	**0**	**SA**	**PDU2 Format**
Data Byte	Length	Parameter Name			Valid Range
1	1 byte	Command Byte			**0xC0**
2	1 byte	Read or Write			**0 = Read, 1 = Write**
3	1 byte	Parameter Group Number			0-255
4	1 byte	Parameter ID Number			0-255
5	4 bytes	Parameter Value			32-bits, byte 5 is LSB, byte 8 is MSB
Configuration Response Message					
PGN		PF	PS	SA	Parameter Group Definition
0xEF00 (61184)		**239**	**0**	**SA**	**PDU2 Format**
Data Byte	Length	Parameter Name			Format
1	1 byte	Command Byte			**0xC0**
2	1 byte	Read/write response or invalid request			**2 = Read response, 3 = Write response, 255 = invalid request**
3	1 byte	Parameter Group Number			0-255
4	1 byte	Parameter ID Number			0-255
5	4 bytes	Parameter Value			32-bits, byte 5 is LSB, byte 8 is MSB

After receiving a valid read message, the UTS-G will send a response message with the Destination Address (DA) set to the Source Address of the requestor. Example (read software version type, major and minor):

- Requestor - (SA = 195): PF = 239, DA = 228, SA = 195, Data = 180 4 0 255 255 255 255 255 (0xB4 4 0 FF FF FF FF FF)
- UTS-G - (SA = 228): PF = 239, DA = 195, SA = 228, Data = 180 4 3 66 1 3 255 255 (0xB4 4 3 42 1 3 FF FF)

When sending a read/write message the Destination Address (DA) must be the Source Address of the UTS-G receiving the message.

Table 6.9:2: Configuration Messages (continued)

Configuration Messages (continued)					
Save Configuration Changes Message					
PGN		PF	PS	SA	Parameter Group Definition
0xEF00 (61184)		**239**	**0**	**SA**	**PDU2 Format**
Data Byte	Length	Parameter Name			Format
1	1 byte	Command Byte			**0xC1**
2	7 bytes	Unused Bytes			0xFFFFFFFFFF
Auto-Offset Command Message					
PGN		PF	PS	SA	Parameter Group Definition
0xEF00 (61184)		**239**	**0**	**SA**	PDU2 Format
Data Byte	Length	Parameter Name			Value
1	1 byte	Command byte			0xB8
2	7 bytes	Unused Bytes			0x00000000000000
UTS-G Configuration Parameter Read/Write/Response[13]					
PGN		PF	PS	SA	Parameter Group Definition
0xEF00 (61184)		**239**	**DA**[14]	**SA**	**Proprietary A**
Data Byte	Length	Parameter Name			Format
1	1 byte	Root ID			Unsigned integer, message function for configuring UTS-G, set by parameter number 003 in Table 5
2	1 byte	Configuration Parameter Number			Unsigned integer, configuration parameter to read/write
3	1 byte	Read/Write/Response			0 = Read configuration parameter, 1 = Write configuration parameter, 3 = Response from UTS-G
4	4 bytes	Data			Configuration parameter specific data **Note: Data may be omitted or set to all 1's for read request**

Configuration Parameter Numbers

Configuration parameters are used to change certain parameters of the devise. The access levels vary from Read Only (R), Read and Write Once (R/Wo), and Read and Write Many (R/W).

Note: If the Source Address is changed with a write message, the UTS-G must respond with a successful Address Claimed (AC) message before resuming other transmissions; otherwise, the Cannot Claim Address message must be sent and the UTS-G must remain silent

Note: The Source Address can only be written in broadcast mode by using the J1939 Commanded Address (CA) message

Table 6.10:1: Configuration Parameter Numbers

Configuration Parameter Numbers							
Group Number	**Parameter Number**	**UTS-G Configuration Parameter**	**Mode**	**R/W[16] Capable**	**Length**	**Format**	**Default**
General Parameters							
0	0	Revision Number	C	R	4 bytes	Unsigned Integer	4
0	01	Platform Software Number	C	R	4 bytes	Unsigned Integer	953610
0	02	Platform Software Version	C	R	4 bytes	Unsigned Integer	215
0	03	Platform Software Build Number	C	R	4 bytes	Unsigned Integer	28
0	04	SAP Part Number	C	R	4 bytes	Unsigned Integer	0xFFFFFFFF
0	05	Serial Number	C	R	4 bytes	Unsigned Integer	0xFFFFFFFF
0	16	CAN Bit Rate	C,S	R/W	4 bytes		250 kbps
0	17	J1939 Source Address (0xE4) [17][18]	B,C,S	R/W	1 byte	Unsigned integer, valid range: 0 to 253, 254 = NULL, 255 = global	228
0	18	J1939 Manufacturer Code	C	R/W	21 bits	Unsigned Long	0
0	19	J1939 ECU Instance	C	R/W	3 bits	Unsigned Long	0
0	20	J1939 Function Instance	C	R/W	5 bits	Unsigned Long	0
0	21	J1939 Function	C	R/W	8 bits	Unsigned Long	136
0	22	J1939 Vehicle System	C	R/W	7 bits	Unsigned Long	0
0	23	J1939 Vehicle System Instance	C	R/W	4 bits	Unsigned Long	0
0	24	J1939 Industry Group	C	R/W	3 bits	Unsigned Long	3
0	25	J1939 Manufacturer Code	C	R/W	11 bits	Unsigned Long	71

Table 6.10:2: Configuration Parameter Numbers (continued)

Configuration Parameter Numbers (continued)							
Group Number	**Parameter Number**	**UTS-G Configuration Parameter**	**Mode**[33]	**R/W**[31] **Capable**	**Length**	**Format**	**Default**
General Parameters							
2	0	Revision	C	R	4 bytes	Integer	4
2	1	Tilt Message Enable	C	R/W	4 bytes	0 Disable, 1 Enable	1
2	2	Tilt Message PGN	C	R/W	2 byes	0xFFAB – 0xFFFF	FFAB
2	3	Tilt Message Rate	C	R/W	4 bytes	5 – 1000 ms period	5
2	4	Tilt Message Range	C	R/W	4 bytes	Unused	0
2	13	SSI2 Message Enable	C	R/W	4 bytes	0 Disable, 1 Enable	1
2	14	SSI2 Message Rate	C	R/W	4 bytes	5 – 1000 ms period	10
2	18	Pitch Offset	C,S,B	R/W	4 bytes	0.001° / bit, 180,000 offset	0
2	19	Roll Offset	C,S,B	R/W	4 bytes	0.001° / bit, 180,000 offset	0
2	20	Tilt X Offset	C,S,B	R/W	4 bytes	0.001° / bit, 180,000 offset	0
2	21	Tilt Y Offset	C,S,B	R/W	4 bytes	0.001° / bit, 180,000 offset	0
2	22	Tilt Z Offset	C,S,B	R/W	4 bytes	0.001° / bit, 180,000 offset	0

7 Application Examples/How Do I…

7.1 Transmitting a command

If the user is broadcasting messages through a CAN tool, then it is possible that the entire 29-bit identifier needs to be set. In a case like this, the typical CAN extended (29-bit) identifier is broken down below

Table 7.1:1: CAN Extended Identifier Example

P/R/DP	PGN	SA
18	EFxx	F9*

- **P/R/DP**: Priority, Reserved, Data Page – A value of **18** is typical for a broadcast message.
- **PGN**: Parameter Group Number – This section changes based on the command sent to the UTS-G. The xx designates the destination address of the sensor being commanded.
- **SA**: Source Address – This section, set to **F9**, can be a number in the set [0-FE]. F9 was used as it is the SA of the tool used.

Table 7.1:2: Data Field Format

DATA Field							
BYTE 1	BYTE 2	BYTE 3	BYTE 4	BYTE 5	BYTE 6	BYTE 7	BYTE 8
CB	R/W	GN	ID	Value 0	Value 1	Value 2	Value 3

- **CB:** Command byte (C0)
- **RW:** Read (0) / Write (1)
- **GN:** Group Number
- **ID:** Identifier Number
- **Value:** 4 byte message.
    - Note: Least significant bit (LSB) is in byte 4 (value 0) and Most significant bit (MSB) is in byte 7 (Value 3)

Using an Identifier of 18xxxxF9, with the x's replaced by the PGN specified in the examples can be used for the following examples.

7.2 Change the UTS-G source address

Instructions

1. Set UTS-G source address – PGN 0xEFE4
2. Save Configuration

EXAMPLE - CHANGE THE UTS-G SOURCE ADDRESS FROM 0XE4 TO 0XE5

1. Send EXT ID 0x18EFE4F9 (Parameter Update from F9 [tool] to E4 sensor)
   Data bytes: C0 01 00 11 E5 00 00 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: C0 03 00 11 FF FF FF FF

2. Send EXT ID 0x18EFE4F9 (Save configuration) –
   Data bytes: C1 FF FF FF FF FF FF FF
   UTS responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: 01 C1 01 00 FF FF FF FF

   Notes:
   - The UTS-G source address is changed 20ms after receiving the Save configuration command.
   - 0xFF is the global broadcast address. The UTS-G will not accept a request to change the source address to 0xFF.

7.3 Change the UTS-G Tilt Message Rate

Instructions

1. Send Command to Write Parameter for Tilt rate to 500.
2. Save Configuration

EXAMPLE - CHANGE THE UTS-G TILT MESSAGE RATE TO 500ms

1. Send EXT ID 0x18EFE4F9 (Parameter Update from F9 [tool] to E4 sensor)
   Data bytes: C0 01 02 07 F4 01 00 00 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: C0 03 02 07 FF FF FF FF

2. Send EXT ID 0x18EFE4F9 (Save configuration) –
   Data bytes: C1 FF FF FF FF FF FF FF
   UTS responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: 01 C1 01 00 FF FF FF FF

   Notes:
   - The UTS-G Tilt Message rate is changed 20ms after receiving the Save configuration command.
   - This sets the message rate to a period of 500ms. 500 in hex is 0x1F4. But when transmitted, it's sent F4, 01, 00, 00. The allowable rate is a period of 5ms to 1000ms.

7.4 Read a UTS-G Parameter

Instructions

1. Send command to read Tilt Message Rate parameter
2. Save Configuration

EXAMPLE - READ THE UTS-G TILT MESSAGE RATE PARAMETER

1. Send EXT ID 0x18EFE4F9 (Parameter Read from F9 [tool] to E4 sensor)
   Data bytes: C0 00 02 07 00 00 00 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: C0 02 02 07 F4 01 00 00

7.5 Auto Offset Command

Instructions

1. Send command to Auto Offset Pitch, Roll, Tilt X, Tilt Y, and Tilt Z
2. Save Configuration

EXAMPLE – AUTO OFFSET

1. Send EXT ID 0x18EFE4F9 (Auto Offset Command from F9 [tool] to E4 sensor)
   Data bytes: B8 00 00 00 00 00 00 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: 01 B8 00 06 00 00 00 00

2. UTS-G sends after 1 second EXT ID 18EFF9E4
   Data bytes: B8 01 FF FF FF FF FF FF

   Notes:
   - The UTS-G takes 1 second of data from the Tilt and Pitch/roll data frames and deducts it from the current value with a resolution of 0.001°/bit to bring the output of all the frames to approximately 0.
   - The values for the offsets are saved in Parameter Group 2, ID's: 18, 19, 20, 21, and 22.
   - Turning off the offset requires writing these parameters to 0x0002BF20 (180,000).

7.6 Manually offset Pitch

Instructions

1. Send command to Write Pitch Offset Parameter to 190.000°
2. Save Configuration

EXAMPLE – MANUAL OFFSET PITCH ONLY (Offset Pitch = Pitch + (Offset – 180,000))

1. Send EXT ID 0x18EFE4F9 (Parameter Update from F9 [tool] to E4 sensor)
   Data bytes: C0 01 02 12 30 E6 02 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: C0 03 02 12 FF FF FF FF

2. Send EXT ID 0x18EFE4F9 (Save configuration) –
   Data bytes: C1 FF FF FF FF FF FF FF
   UTS responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: 01 C1 01 00 FF FF FF FF

Notes:

- The UTS-G Pitch Offset is updated 20ms after receiving the Save configuration command.
- The offset in this example is 10.000 degrees. The internal offset is -180.000°. The value to get a 10.000° positive offset is 190.000°, or 190,000 = 0x0002E630.

7.7 Turn Off SSI2 Message

Instructions

1. Send command to turn of SSI2 message frame
2. Save Configuration

EXAMPLE – TURN OFF SSI2 MESSAGE

1. Send EXT ID 0x18EFE4F9 (From F9 tool to E4 sensor)
   Data bytes: C0 01 02 0D 00 00 00 00
   UTS-G responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: C0 03 02 0D FF FF FF FF

2. Send EXT ID 0x18EFE4F9 (Save configuration) –
   Data bytes: C1 FF FF FF FF FF FF FF
   UTS responds with EXT ID 0x18EFF9E4 (acknowledge) –
   Data bytes: 01 C1 01 00 FF FF FF FF

Notes:

- The UTS-G SSI2 message will turn off 20ms after receiving the Save configuration command

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8 Performance Considerations

The UTS-G is an angle sensor that uses an accelerometer to calculate changes in orientation. There are a few factors that may influence the operation.

Vibrations
Due to the use of high-resolution accelerometers, vibrations can cause interference in certain applications. Once the device is installed, it is recommended to operate all functions that may cause sudden vibrations/shock across the vehicle to ensure regular operation is not interrupted. These instances will be picked up by the UTS-G as angular changes and could have an adverse effect on regular operation depending on the application.

If it is determined that there is interference due to vibration, here are some solutions to investigate:

- Ensure consistency with mounting recommendations outlined in this document is maintained
- Increase programable filtering
- Reduce the output resolution
- Add vibration isolation (rubber dampeners)
- Increase thickness of mounting surface
- Reduce the vibrations from the source
- Relocate the sensor to an area of lower vibration
- Avoid installing the UTS-G in areas that are susceptible to large sonic vibrations

Operation at Extreme Linear Limits
It is recommended to avoid using extreme linear limits for critical angular measurements. Consider setting up an operated range that is enclosed by a diagnostic zone at the limits of angular range. It is common practice to allow 5-10% of the full range for these zones.

Unsigned Integers
The UTS-G broadcasts tilt angles using unsigned 16-bit integers with 0˚ offset, and pitch and roll angles using unsigned integers with -250˚ offset.

Using multiple sensors on the same CAN bus system
Each UTS-G will need to have a unique source address.

9 FAQ

The FAQ for UTS-G can be found at http://blog.parker.com/faqs for additional product support.

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