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Nationales Vorwort

Dieses Dokument (EN 16603-50-14:2014) wurde vom Technischen Komitee CEN/CLC/TC 5 „Raumfahrt“ erarbeitet, dessen Sekretariat vom DIN (Deutschland) gehalten wird.

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Dieses Dokument (EN 16603-50-14:2014) basiert auf ECSS-E-ST-50-14C.

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung von EN 16603-50-14:2014.

Dieses Dokument wurde speziell zur Behandlung von Raumfahrtsystemen erarbeitet und hat daher Vorrang vor jeglicher Europäischer Norm, da es denselben Anwendungsbereich hat, jedoch über einen größeren Geltungsbereich (z. B. Luft- und Raumfahrt) verfügt.

Nationaler Anhang NA (informativ)

Begriffe und Abkürzungen

3 Begriffe und Abkürzungen

3.1 Begriffe aus anderen Normen

Für die Anwendung dieses Dokuments gelten die Begriffe nach ECSS-S-ST-00-01.

3.2 Für diese Norm spezifische Begriffe

3.2.1

Genauigkeit

Nähe der Messung zum tatsächlichen Wert, der gemessen wird

ANMERKUNG Für die Anwendung dieses Dokuments wird sie als prozentualer Anteil des gesamten Messbereichs oder als absoluter Wert angegeben.

3.2.2

Pfad

Leiterbahn, die ein Signal durch eine Schnittstelle von der Quelle zu dessen Bestimmungsort befördert

ANMERKUNG Ein Pfad umfasst die Innenleiter, jeden dazwischenliegenden Anschluss und sämtliche Pfadbestandteile, wie z. B. Schutzwiderstände und Kopplungskondensatoren, aus denen der Signalweg besteht.

3.2.3

Austauschbus für DHS-Daten

zugrundeliegendes Kommunikationsmedium, das die zentralen DHS-Elemente verbindet

ANMERKUNG Dieser kann aus mehr als einem physikalischen Bus bestehen.

3.2.4

zentrales DHS-Element

Bestandteil eines Datenverarbeitungssystems, der über eine Direktverbindung zum Austauschbus für DHS-Daten verfügt

ANMERKUNG Z. B. Bussteuerung und rechnerferne Endgeräte.

3.2.5

peripheres DHS-Element

Bestandteil eines Datenverarbeitungssystems, der über keine Direktverbindung zum Austauschbus für DHS-Daten verfügt

ANMERKUNG Z. B. Messwertgeber und Aktoren.

3.2.6

Verlagerungsspannung des Massepotentials

Spannungsunterschied zwischen den Massebezugspotentialen von Quelle und Empfänger

ANMERKUNG Anwender sind aufgefordert, diese Definition anstelle der „Asymmetrischen Spannung“ zu verwenden, die bei Bezugnahme auf die wissenschaftliche Definition ungenau ist.

3.2.7

zeitlicher Bezugspunkt

Zeitpunkt, zu dem ein Zeitbereich beginnt oder endet

ANMERKUNG Der zeitliche Bezugspunkt ist der Mittelpunkt zwischen der nominell hohen und der nominell niedrigen Signalspannung.

3.3 Abkürzungen

Für die Anwendung dieses Dokuments gelten die Abkürzungen nach ECSS-S-ST-00-01 und die folgenden Abkürzungen:

Abkürzung	Bedeutung
A/D	analog in digital (en: analogue to digital)
ADC	A/D-Wandler (en: analogue digital converter)
ASM	analoger Signalmonitor (en: analogue signal monitor)
BDM	zweistufiger diskreter Monitor (en: bi-level discrete monitor)
BSD	bidirektional seriell digital (en: bi-directional serial digital)
BSM	Monitor für zweistufigen Schalter (en: bi-level switch monitor)
CM	Gleichtakt (en: common mode)
DHS	Datenverarbeitungssystem (en: data handling system)
HPC	Hochleistungsimpuls-Befehl (en: high power command)
HC-HPC	Hochstrom-Hochleistungsimpuls-Befehl (en: high current high power command)
HV-HPC	Hochspannungs-Hochleistungsimpuls-Befehl (en: high voltage high power command)
ISD	serielle digitale Eingabe- (en: input serial digital)
LPC	Kleinsignal-Steuerbefehl (en: low power command)
LPC-P	Kleinsignal-Steuerbefehl, gepulst (en: low power command, pulsed)
LPC-S	Kleinsignal-Steuerbefehl, statisch (en: low power command, static)
LSB	niedrigstwertiges Bit (en: least significant bit)
LV-HPC	Niederspannungs-Hochleistungsimpuls-Befehl (en: low voltage high power command)
MSB	höchstwertiges Bit (en: most significant bit)
OBDAH	Datenhandhabung an Bord (en: on-board data handling)
OSD	serielle digitale Ausgabe- (en: output serial digital)
TSM	Monitor für Temperaturmessfühler (en: temperature sensors monitor)

3.4 Konventionen

3.4.1 Konvention zur Bit-Nummerierung

Das höchstwertige Bit eines n-bit-Feldes ist:

- das mit 0 (Null) nummerierte Bit;
- das erste übertragene Bit, und
- das am weitesten links stehende Bit eines Formatdiagramms.

Das niedrigstwertige Bit eines n-bit-Feldes ist:

- das mit $n-1$ nummerierte Bit;
- das letzte übertragene Bit, und
- das am weitesten rechts stehende Bit eines Formatdiagramms.

Diese Konvention wird in Bild 3-1 dargestellt.

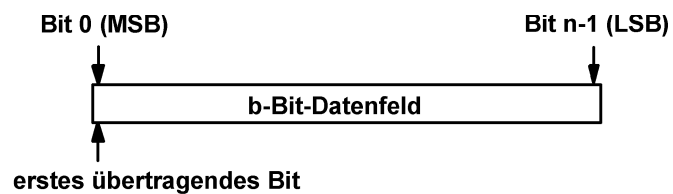


Bild 3-1 — Konvention zur Bit-Nummerierung

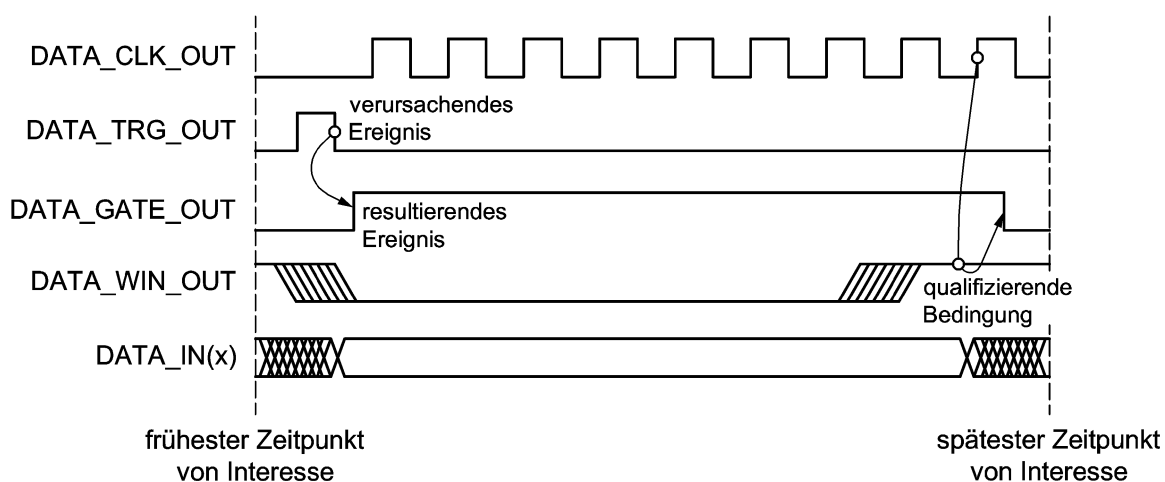
3.4.2 Konventionen zum Zeitdiagramm

Zeitdiagramme werden immer mit dem frühesten Zeitpunkt am linken Rand und der fortschreitenden Zeit zur Rechten erstellt.

Wenn ein Ereignis, wie z. B. ein Übergang, bei einem Signal ein Ereignis bei einem anderen Signal auslöst, werden beide Signale durch einen Pfeil miteinander verbunden, wobei das Pfeilende beim verursachenden Ereignis ansetzt und die Pfeilspitze auf das resultierende Ereignis zeigt.

Wenn ein Ereignis bei einem Signal das Ergebnis eines Ereignisses bei einem anderen Signal ist und die qualifizierende Bedingung für ein weiteres oder mehrere weitere Signale darstellt, ist der verbindende Pfeil mit den regelnden Voraussetzungen durch einen kleinen Kreis mit Mittelpunkt verbunden.

Diese Konventionen werden gemeinsam mit den anderen Symbolen für Zeitdiagramme in Bild 3-2 dargestellt.



Legende

-  Zu vernachlässigen, Spannung kann sich ändern.
-  Signal wird sich von schwach zu stark ändern.
-  Signal wird sich von stark zu schwach ändern.
-  Signal kann stark oder schwach sein, muss jedoch stabil sein.

Bild 3-2 — Konventionen zum Zeitdiagramm

3.4.3 Konvention zur Benennung von Signal und Signalereignis

Signale werden so benannt, dass der Name die Funktion dieses Signals anzeigt. So kann z. B. eine Uhr, die für eine Datenbit-Abtastung verwendet wird, DATA_CLK benannt werden.

Die Benennung von Steuersignalen ist sinnvoll, wenn die Funktion des Signals, dessen Richtung und dessen Erklärungsebene angegeben werden. Die Richtung wird in Bezug auf das zentrale DHS-Element angegeben, so dass ein OUT-Signal eine Ausgabe bedeutet, d. h. vom zentralen Element weg. Ein IN-Signal stellt eine Eingabe für das zentrale Element dar. So wird z. B. ein Signal, das Daten aus dem zentralen Element heraus transportiert, mit DATA_OUT bezeichnet.

Steuersignale oder Gültigkeitsebenen werden in Klammern angegeben. So wird z. B. ein Gate-Ausgangssignal, das angegeben wird, wenn es schwach ist, GATE_OUT(L) benannt. Auf ähnliche Weise wird ein Eingangssignal, das anzeigt, dass das Gerät betriebsbereit ist, READY_IN(H) benannt, wenn es stark ist.

Signalereignisse, wie z. B. Übergänge oder Impulse, werden gleichfalls symbolisch benannt, wobei die Indizes „UP“ und „DOWN“ verwendet werden. So zeigt z. B. START_{UP} ein steigendes Flankenereignis am Startsignal an und STOP_{DOWN} bedeutet ein fallendes Flankenereignis am Stoppsignal. RUN_{UPDOWN} zeigt einen positiven Impuls am Betriebssignal an, während HALT_{DOWNUP} einen negativen Impuls am Haltsignal anzeigt.

3.4.4 Referenzen für die zeitlichen Abläufe und das Messen von Signalen

Signalaufbau- und -abbauzeiten, wie in Bild 3-3 gezeigt, werden, wie aus dem vorstehend benannten Bild zu ersehen ist, im Bereich, der zwischen 10 % und 90 % des Unterschiedes zwischen der nominell unteren und der nominell oberen Signalspannung liegt, gemessen.

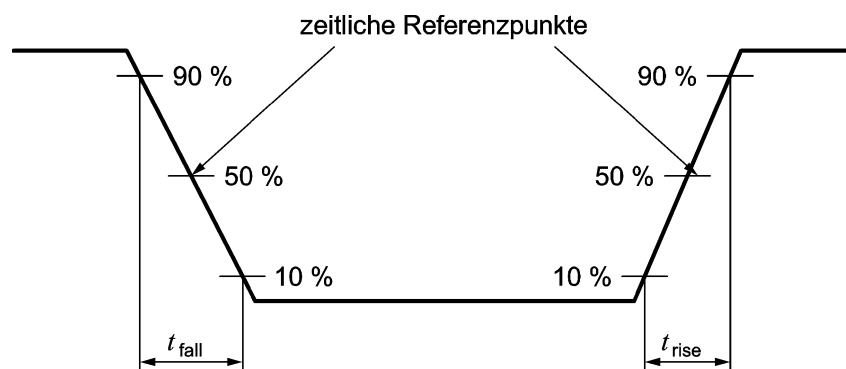


Bild 3-3 — Referenzen für die zeitlichen Abläufe und das Messen von Signalen

— Leerseite —

English version

Space engineering - Spacecraft discrete interfaces

Ingénierie spatiale - Interfaces électriques discrètes pour
satellites

Raumfahrttechnik - Diskrete Schnittstellen in
Raumfahrzeugen

This European Standard was approved by CEN on 1 March 2014.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN and CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Foreword

This document (EN 16603-50-14:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16603-50-14:2014) originates from ECSS-E-ST-50-14C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1

Scope

This standard specifies a common set of spacecraft onboard electrical interfaces for sensor acquisition and actuator control. The interfaces specified in this standard are the traditional point-to-point interfaces that are commonly used on modern spacecraft.

The interfaces specified in this standard include analogue and discrete digital interfaces used for status measurement and control, as well as point-to-point serial digital interfaces used for digital data acquisition and commanding of devices.

This standard specifies:

- interface signal identification;
- interface signal waveforms;
- signal timing requirements;
- signal modulation;
- voltage levels;
- input and output impedance;
- overvoltage protection requirements;
- bit ordering in digital data words;
- cabling requirements where appropriate.

This standard does not cover:

- connector requirements;
- digital data word semantics;
- message or block formats and semantics.

Connector requirements are not covered because these are normally mission or project specific. The goal of this standard is to establish a single set of definitions for these interfaces and to promote generic implementations that can be re-used throughout different missions.

When referred, the present standard is applicable as a complement of the already existing interface standards ANSI/TIA/EIA-422B-1994 and ITU-T Recommendation V.11 (Previously “CCITT Recommendation”) – (03/93).

Guidance for tailoring of the present standard can be found in Annex A.

This Standard may be tailored for the specific characteristics and constraints of a space project in conformance with ECSS-S-ST-00.

Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications, do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
	ANSI/TIA/EIA-422B-1994	Electrical characteristics of balanced voltage digital interface circuits
	ITU-T Recommendation V.11 (Previously "CCITT Recommendation") – (03/93)	Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s

NOTE This document is technically equivalent to ANSI/TIA/EIA/422B-1994.

3

Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 apply.

3.2 Terms specific to the present standard

3.2.1 accuracy

closeness of a measurement to the actual quantity being measured

NOTE For the purposes of this Standard it is expressed as percentage of the full measurement range or as an absolute value.

3.2.2 circuit

conducting path which conveys a signal across the interface from the signal source to the signal destination

NOTE A circuit includes the cable conductor, any intervening connectors, and any circuit elements such as protection resistors and coupling capacitors, which make up the signal path.

3.2.3 DHS data interchange bus

underlying communication medium which connects the DHS core elements

NOTE This can consist of more than one physical bus.

3.2.4 DHS core element

component of a data handling system which has a direct connection to the DHS data interchange bus

NOTE E.g.: bus controllers and remote terminals.

3.2.5 DHS peripheral element

component of a data handling system which does not have a direct connection to the DHS data interchange bus

NOTE E.g.: sensors and actuators.

3.2.6 ground displacement voltage

voltage difference between source and receiver ground references

NOTE Users are encouraged to use this definition instead of 'common mode voltage' that is not correct when referring to the academic definition.

3.2.7 time reference point

point at which a time interval starts or ends

NOTE It is the mid point between the nominal high and nominal low signal voltages.

3.3 Abbreviated terms

For the purpose of this standard, the abbreviated terms of ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
A/D	analogue to digital
ADC	analogue digital converter
ASM	analogue signal monitor
BDM	bi-level discrete monitor
BSD	bi-directional serial digital
BSM	bi-level switch monitor
CM	common mode
DHS	data handling system
HPC	high power command
HC-HPC	high current high power command
HV-HPC	high voltage high power command
ISD	input serial digital
LPC	low power command
LPC-P	low power command, pulsed
LPC-S	low power command, static
LSB	least significant bit
LV-HPC	low voltage high power command
MSB	most significant bit
OBDAH	on-board data handling
OSD	output serial digital
TSM	temperature sensors monitor

3.4 Conventions

3.4.1 Bit numbering convention

The most significant bit of an n-bit field is:

- numbered bit 0 (zero),
- the first bit transmitted, and
- the leftmost bit on a format diagram.

The least significant bit of an n-bit field is:

- numbered bit n-1,
- the last bit transmitted, and
- the rightmost bit on a format diagram.

This convention is illustrated in Figure 3-1.

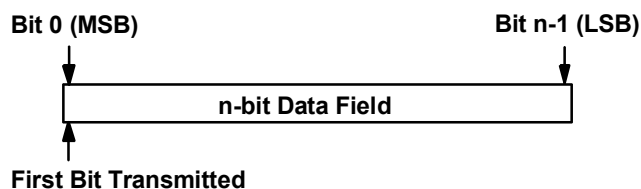


Figure 3-1: Bit numbering convention

3.4.2 Timing diagram conventions

Timing diagrams are always drawn with the earliest time on the left and time advancing to the right.

Where an event, such as a transition, in one signal causes an event in another, the two events are linked by an arrow with the tail of the arrow on the causal event and the head of the arrow on the resultant event.

Where an event in one signal is the result of an event in another signal and a qualifying condition in one or more other signals, the connecting arrow is associated with the governing condition using a bull's eye.

These conventions, together with other timing diagram symbols, are shown in Figure 3-2.

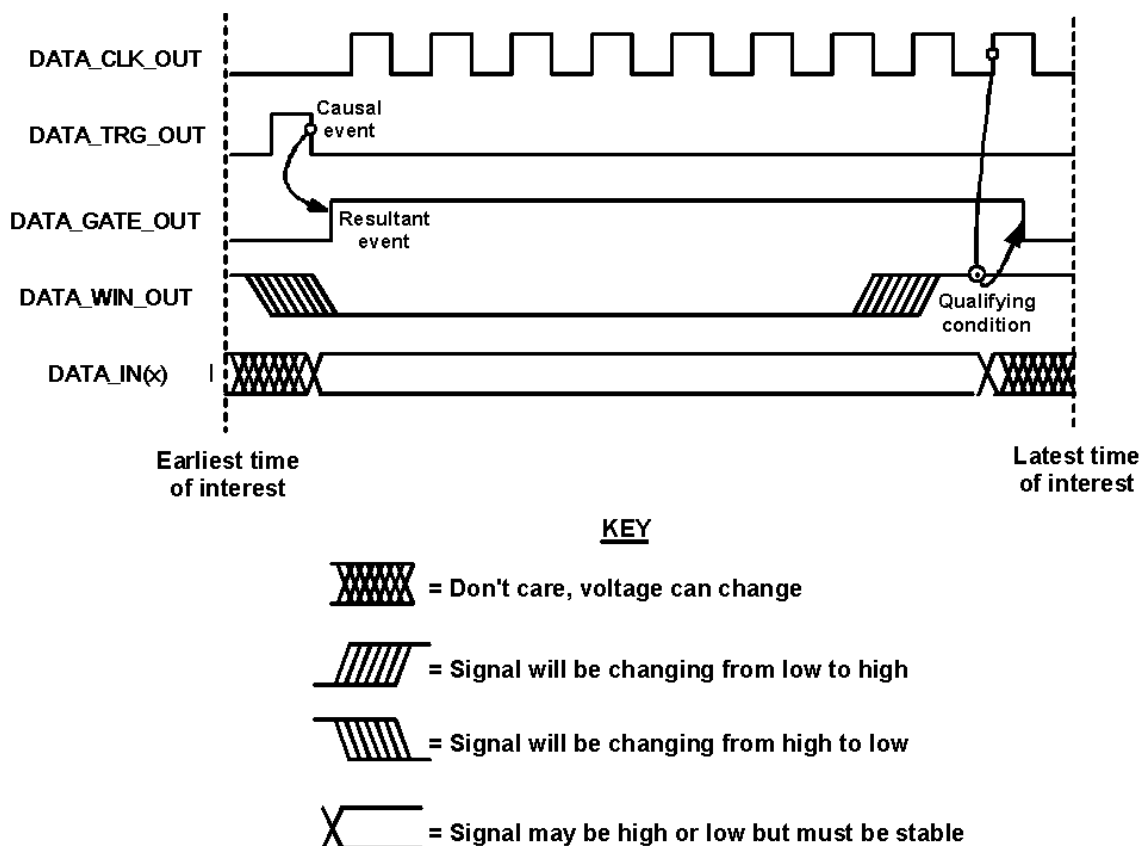


Figure 3-2: Timing diagram conventions

3.4.3 Signal and signal event naming convention

Signals are named in a manner which indicates the function of that signal. For example, a clock used for data bit sampling can be called DATA_CLK.

Control signal naming is meaningful with the function of the signal, its direction, and its assertion levels all indicated. The direction is indicated with respect to the DHS core element so that an OUT signal is an output, i.e. driven from the core element. An IN signal is an input to the core element. For example, a signal carrying data out of the core element is named DATA_OUT.

Control signal assertion or validity levels are indicated within brackets. For example, a gate output signal which is asserted when low is named GATE_OUT(L). Similarly, an input signal which indicates that a device is ready when it is high is named READY_IN(H).

Signal events such as transitions and pulses are also named symbolically using "UP" and "DOWN" indication. For example, START_{UP} indicates a rising edge event on the start signal, and STOP_{DOWN} indicates a falling edge on the stop signal. RUN_{UPDOWN} indicates a positive going pulse on the run signal, while HALT_{DOWNUP} indicates a negative going pulse on the halt signal.

3.4.4 Signal timing and measurement references

Signal rise and fall times, which are shown in Figure 3-3, are measured between 10 % and 90 % of the difference between the nominal low and nominal high signal voltages, as it can be seen in the mentioned figure.

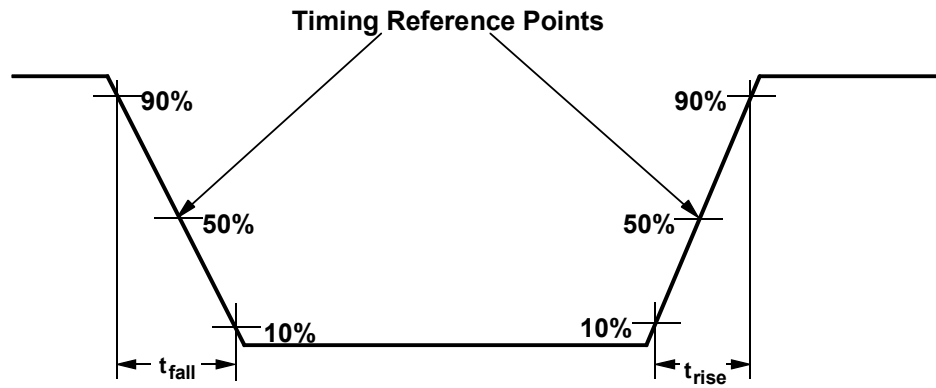


Figure 3-3: Signal timing and measurement references

4

General

4.1 Introduction

This standard defines electrical interfaces for use onboard spacecraft to connect simple devices such as sensors and actuators to the data handling system. The interfaces defined are:

- analogue signal interfaces (clause 5)
 - analogue signal monitor
 - temperature sensor monitor
- bi-level discrete input interfaces (clause 6)
 - bi-level discrete monitor
 - bi-level switch status monitor
- command interfaces (clause 7)
 - high power pulse command
 - low power command
- serial digital interfaces (clause 8).

Each interface is defined in terms of the electrical and timing characteristics of the signals comprising that interface. Connectors for the interfaces are not defined because these are often highly project dependent. Cabling characteristics are defined where appropriate.

For the serial digital interfaces, the data content of the digital words is not defined since this is the subject of higher level protocol standards beyond the scope of this Standard.

Unless otherwise stated, specified performances are applicable when both source and receiver are powered.

4.2 Architectural concepts

4.2.1 Overview

The interfaces specified in this Standard are intended to connect DHS core elements to DHS peripheral elements as shown in Figure 4-1. However, there are no technical reasons to prevent these interfaces being used between core

elements where it is appropriate to do so, and this Standard does not preclude such a configuration.

A peripheral element can have more than one user interface and also user interfaces of different types, depending on its function and design. For example, some sensors can set threshold levels or sensitivities by means of data written to them. In this case that sensor can use an output serial digital interface to write the data in addition to an input serial digital interface to read the sensor value. Alternatively, some devices are signalled to indicate that they are commanded to acquire a data sample. In that case they can use a serial digital interface together with a pulse interface.

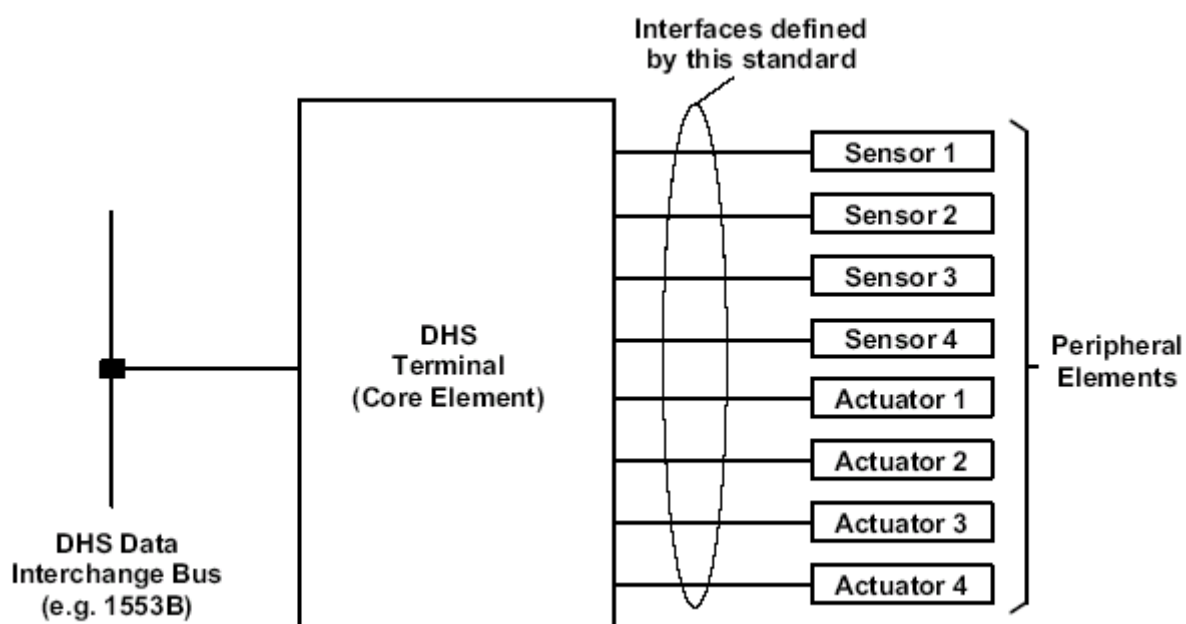


Figure 4-1: Architectural context of interfaces defined in this standard

4.2.2 General failure tolerance

4.2.2.1 Input interfaces

- a. Among other failure cases, receivers shall:
 1. Not be stressed and not show degraded performance when input is open circuit except on the input I/F that is open circuit.
 2. Not be stressed and not show degraded performance when input is short circuit to ground except on the input I/F that is short circuit.

NOTE No specific performance requirements are imposed while in this status.

4.2.2.2 Output interfaces

- a. Among other failure cases, transmitters shall:
1. Not be stressed and not show degraded performance when output is open circuit except on the output I/F that is open circuit.
 2. Not be stressed when output is short circuit to ground.

NOTE No specific performances requirement is imposed while in this status.

4.2.3 Interface control during power cycling

4.2.3.1 Input interfaces

- a. Input interfaces shall not be damaged or harmed during power cycling conditions taking the transmitting side state into account in any normal state or applicable failure condition.
- b. Receivers shall not deliver power to the other circuits or be stressed when the unit is OFF while connected to an active driver.

NOTE No specific performance requirements are imposed while in this status.

4.2.3.2 Output interfaces

- a. Output interfaces shall not be damaged or harmed during power cycling conditions when the receiving side state is in any normal state or specified failure condition.

NOTE No specific performance requirements are imposed while in this status.

- b. For pulse commands it shall be ensured that spurious commands are not emitted during power cycling that exceed activation limits for the receivers.

NOTE 1 For pulse commands, see Clause 7.

NOTE 2 This requirement does not specify the prevention of spurious pulses, but ensures either that:

- spurious pulses are below the threshold for the receiver, or
- the spurious pulse duration is short enough to not drive the load into activation (for example a relay coil or opto-coupler diode).