



**Implementation Guide for the Common
Electrical Interface (CEI 2.0)**

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Abstract: This document provides text for proposed corrections, clarifications, and improvements to the Common Electrical Interface (CEI-2.0) Implementation Agreement. It is the product of the CEI maintenance work conducted in the PLL Working group in accordance with maintenance procedures set out in OIF2002.266.00.

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2 Scope and Purpose

This document provides the text for proposed corrections, clarifications and enhancements to the OIF Implementation Agreement: “Common Electrical I/O (CEI) - Electrical and Jitter Interoperability agreements for 6G+ bps and 11G+ bps I/O”. Section 3 covers editorial changes, Section 4 reviews proposed changes to improve the clarity of the document and Section 5 discusses the proposed corrections and enhancements to CEI.

3 Editorial Changes

The proposed editorial corrections to CEI -02.0 are summarized in Table 1 below:

Table 1 Editorial Changes

Item	Section	Page	Line	Change from	To
1	2.5.4	45	3	"The following steps shall be made to identify whether a transmitter is considered compliant"	"The following steps shall be made to identify whether a receiver is considered compliant".
2	9.2.7.1	163	17	"3. Effective Driver UUGJ, UHBHPJ and DCD as in Table 9-3 "	"3. Effective Driver UUGJ, UBHPJ and DCD as in Table 9-3 ".
3	2.C.3	56	33	"a jitter is observed which has a direct correlation to the data pattern being transmitter."	"a jitter is observed which has a direct correlation to the data pattern being transmitted."
4	2.1.2 2.1.3 2.1.4 2.2.2 2.2.3 2.2.4 2.3.2 2.3.3 2.3.4 2.4.2 2.4.3 2.4.4 2.5.2 2.5.3 2.5.4	35 36 36 37 38 38 39 40 40 41 42 42 43 44 45	43 22 40 22 1 28 15 1 29 14 1 28 36 19 1	"Interoperability" (in subsection titles)	"Compliance"

Items 1, 2, and 3 are corrections to typographical errors. Item 4 is changed to more accurately describe the purpose of the tests outlined in these sub clauses.

4 Clarification Changes

The proposed clarification changes to CEI -02.0 are summarized in Table 2 below.

Table 2 Clarification Changes

Item	Section	Page	Line	Change from	To
1	1.6	23	4	"Golden Channel - Refers to an electrical channel which is usually identified using a channel compliancy methodology and is used in the testing of transmitters and receivers "	"Stress Channel - An otherwise compliant channel that has been selected or altered to test receiver or transmitter compliance (see also stressed signal, stressed eye)."
2	2.D.1.1	70	36	"or by performing the measurement at the end of a Golden Channel"	"or by performing the measurement at the output of a Stress Channel"
3	2.D.4.3	79	9	"Compliant Channel or Filter "	"Stress Channel"
4	2.D.4.3	79	31	"A compliance channel shall be added"	"The Stress channel shall have the characteristics specified in the relevant test method."
5	2.2.3	38	9	"A "compliance" channel as per 2.2.2 that required at least half the maximum transmit emphasis give an open eye. "	"A Stress channel that is otherwise compliant as per 2.2.2, that requires at least half the maximum transmit emphasis, as specified in the relevant clause or IA, with no receiver filtering or equalisation to produce an open eye"
6	2.3.3	40	9	"A "compliance" channel as per 2.3.2 that required at least half the maximum defined transmit emphasis, as in the specific IA, with no receiver filtering to give an open eye. "	"A Stress channel that is otherwise compliant as per 2.3.2, that requires at least half the maximum transmit emphasis, as specified in the relevant clause or IA, with no receiver filtering or equalisation to produce an open eye"
7	2.4.3	42	9	"A "compliance" channel as per 2.4.2 that required at least half the maximum transmit emphasis with no receiver filtering to give an open eye. "	"A Stress channel that is otherwise compliant as per 2.4.2, that requires at least half the maximum transmit emphasis, as specified in the relevant clause or IA, with no receiver filtering or equalisation to produce an open eye"
8	2.3.4	40	43	"A compliance channel or filter as identified by Chapter 2.3.2."	"A Stress channel or filter as identified by Chapter 2.3.2 with no Transmit Emphasis enabled in the Reference Transmitter ."
9	2.4.4	42	42	"A compliance channel or filter as identified by Chapter 2.4.2."	"A Stress channel or filter as identified by Chapter 2.4.2 with no Transmit Emphasis enabled in the Reference Transmitter ."

These changes are largely related to electrical Channels used in the compliance testing of CEI transmitters and receivers. In CEI-02.0, the terms: "Golden Channel" and "Compliance Channel" are both used to refer to such channels. The term "Compliance Channel" may result in additional confusion as the term: "Compliant Channel" is also used in CEI-02.0 to describe a Channel which meets the requirements of CEI-02.0. It was therefore determined to replace "Compliance Channel" and "Golden Channel" with the term: "Stress Channel".

The evaluation of a Stress Channel is performed in a similar fashion to the evaluation of a channel for compliance to a CEI clause. Both are performed using the Statistical Eye method described in Section 2.C.5 of CEI-02.0. However while the specified reference receiver and transmitter are used in the Statistical Eye analysis for assessing channel compliance, for receiver or transmitter testing the characteristics of the instrumentation used should be reflected in the Statistical Eye analysis. For receiver testing, therefore, the reference transmitter is replaced by one representing the BERT (as shown in the test setup of Figure 2-31, for example) and will have no transmit emphasis. Similarly, for transmitter testing, the receiver is replaced by a Sampling Oscilloscope. The reference receiver should therefore be replaced by a receiver with similar characteristics, that is, no receiver equalization. The proposed text changes in Table 2 also seek to clarify these requirements.

5 Corrections and Enhancements to CEI-02.0

The proposed corrections and enhancements to CEI -02.0 are summarized in Table 3 below.

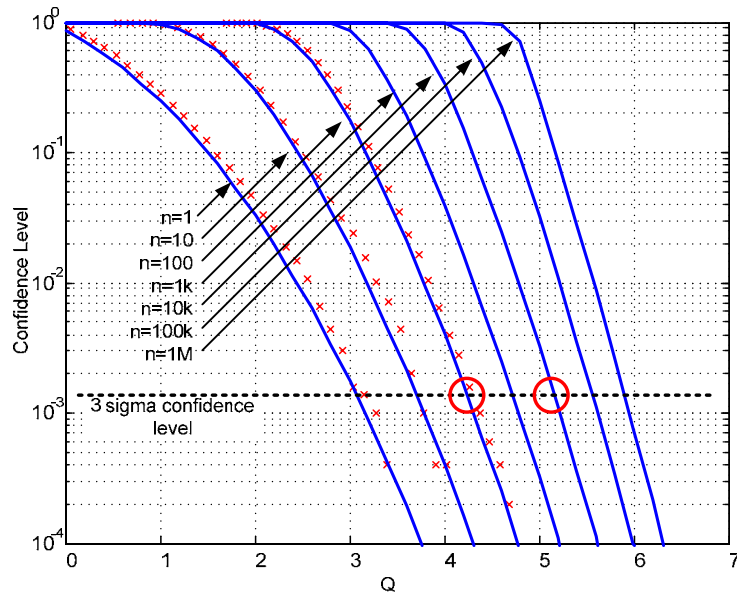
Table 3 Correction and Enhancements

Item	Section	Page	Line	Change from	To
1	2.E.3.2	87	18	Replace Figure 2-37 with updated version correcting position of 3 Sigma Confidence Level Line	
2	2.D	70	1	Place the description of CEI Test Patterns contained in Section 5.2 into the CEI Document as "2.D Annex – Definition of CEI Test Patterns" Re-number the existing Sections 2.D and 2.E as 2.E and 2.F respectively.	
3	2.1.1	35	16 - 41	Replace entire Sections "2.x.1 Defined Test Patterns"	"2.x.1 Defined Test Patterns The test pattern to be used for output Jitter and jitter tolerance compliance testing should be chosen for the type of data that the link will carry in accordance with Table 2.1 of Annex 2.D.
	2.2.1	37	14 -19		
	2.3.1	39	8 -14		
	3.4.1	41	8 - 12		
	3.5.1	43	8 - 34		
	2.1.1	35	49	Remove footnotes "All descriptions to PRBS31 imply the standard polynomial as described in [21]"	
	2.2.1	37	49		
	2.3.1	39	49		
	3.4.1	41	49		

5.1 Corrections to Figure 2-37

This corrects an error in Figure 2-37 where the "3-sigma confidence level" line was incorrectly placed. The corrected figure appears as below:

Figure 2-37. Cumulative Distribution Function of Maximum Amplitude



5.2 Definition of new CEI Test Patterns

The addition of several new CEI Test patterns is in response to requests for shorter tests patterns to permit the use of “known pattern” methods of Jitter and Eye Diagram measurement. The intention was to create Test patterns which were 32,768 bits long or less based on the capabilities of some commonly used pieces of test equipment. The analysis of these, and other, patterns using the criteria set out in Section 2.D.2 of the proposed new text may be found on the OIF Web Site in the: “CEI Short Stress Patterns White Paper” by Pete Anslow.

----- Start of New Text -----

2.D Annex – Definition of CEI Test Patterns

2.D.1 Annex – PRBS31

The pattern is a free running PRBS31 polynomial in accordance with [21]. The sequence is generated using taps 28 and 31.

2.D.2 Annex – Short Stress Pattern Random (SSPR)

The SSPR pattern was chosen to have baseline wander and timing content that are at least as stressful as 10,000 years of random binary.

- The baseline wander was assessed with a cut-off frequency of baud/10,000
- The clock content was assessed with a corner frequency of baud/1667

- Total length 32,762 bits
- All $2^{28}-1$ PRBS28 sequences are generated using taps 25 and 28
- Block 1 is A1 (11110110) repeated 192 times to give 1536 bits
- Block 2 is A2 (00101000) repeated 192 times to give 1536 bits
- Block 3 is the National Use bits and consists of 1010 repeated for 1026 bits
- Block 4 takes 4071 bits of PRBS28 seed = 0x0080080 and codes it:
 - A zero is encoded as a change of output
 - A one is encoded as no change of output
 - The output before the first bit is assumed to have been a 0
 - This block begins
1010101001010101010110101010101011011010
- Block 5 is 1 followed by 72 x 0
- Block 6 is 4071 bits of PRBS28 seed = 0xFFFFFFFF and begins 28 x 1, 25 x 0, 3 x 1, 22 x 0 ...
- Block 7 is 4068 bits of PRBS28 seed = 0x0080080 and begins with 8 x 0, 1, 11 x 0, 1, 12 x 0, 1 ...
- Blocks 8 to 14 are the inverse of 1 to 7

Under some circumstances (e.g. to accommodate the restrictions of some pieces of test equipment) it may be desirable to modify this short pattern to have a total length of 32,768 bits (2^{15}) rather than 32,762 bits. To make use of this option, the last block in each half (blocks 7 and 14) should be extended by 3 bits making these blocks 4071 bits long.

2.D.5 Annex – Use of CEI Test Patterns

The Test patterns required for the various electrical interfaces covered by CEI are specified in Table 2.1.

Table 2.1 Annex – Use of CEI Test Patterns

Electrical Requirement	"Method"	IA	Data	Test Patterns	
				Mandatory	Recommended
CEI Clause 4 (SxI-5)	A	SFI-4.2	Scrambled	PRBS31 or SSPR	SSPR SSPS-16
		Other	Scrambled	PRBS31 or SSPR	
		SPI-5	Scrambled	PRBS31 or SSPR	
		SFI-5.1	Partially Scrambled	PRBS31 or SSPR	
		SFI-5.1s	Partially Scrambled	PRBS31 or SSPR	
CEI Clause 5 TFI-5	B	TFI-5	Scrambled Partially Scrambled	PRBS31 or SSPR PRBS31 or SSPR	SSPS-16
CEI Clause 6 CEI6G-SR	B	TDM-P	Scrambled	PRBS31 or SSPR	SSPS-16
		CEI-P	Scrambled	PRBS31 or SSPR	
		Other	Scrambled	PRBS31 or SSPR	
		Other	Partially Scrambled	PRBS31 or SSPR	
CEI Clause 7 CEI6G-LR	D	TDM-P	Scrambled	PRBS31 or SSPR	SSPS-16
		CEI-P	Scrambled	PRBS31 or SSPR	
		Other	Scrambled	PRBS31 or SSPR	
		Other	Partially Scrambled	PRBS31 or SSPR	
CEI Clause 8 CEI11G-SR	E	TDM-P	Scrambled	PRBS31 or SSPR	SSPS-64
		CEI-P	Scrambled	PRBS31 or SSPR	
		SFI5.2	Scrambled	PRBS31 or SSPR	
		Other	Scrambled	PRBS31 or SSPR	
		Other	Partially Scrambled	PRBS31 or SSPR	
CEI Clause 9 CEI11G-LR/MR	?	TDM-P	Scrambled	PRBS31 or SSPR	SSPS-64
		CEI-P	Scrambled	PRBS31 or SSPR	
		Other	Scrambled	PRBS31 or SSPR	
		Other	Partially Scrambled	PRBS31 or SSPR	

2.D.6 Annex – Text Definitions of Patterns

Below are definitions of the patterns described in Sections 2.D.2, 2.D.3 and 2.D.4 as hexadecimal digits with the most significant bit of each digit transmitted first.

Since these patterns are 32,762 bits long (which is not divisible by 4), the two least significant bits of the last digit shown are not included in the sequence.

Short Stress Pattern Random (SSPR)

```

008008004804802082081249248800000C8000068800032C8001A48800C80C8068868832
CB2C9A49248480000A080005A480028808016C8480A08A085A4DA4A882081EC9248E8800
0FAC80072C8803E48C81CC0E88FAC7ACF2CFACB64B2C90412481248008800804C8048228
820936C924080800448480260A081165A489A4880C480C86E0868B1E4B2D3EC1244C8C80
628E88376FAC98C12C85EC848AA88A0DFECDA6208A09724DA42E020855E124FAFAE801D2D
A80F440E875647ABDE47AF52C7AD5C4FAC7BE32CFA4FA4B283281269A68812492C880004
8C80020E880127AC8081AC8848CC8CA0EA8E9A7BEFA49A4928048006820803292481A600
08C96004E826023A91613EE1A68C9EC92E868805AB2C828F24896F600C214606D2B76304
70C7B27F6FA218412B2DA48724080BE044854E260AF3F165D6C7A4B60FA810672E8935E5
AC09AC8CC44C8EAE628FBDD76F2536C160C80CA668869952CB253C4920CDE0026A2E0113
B5E098E1AE45FECDC6A08A3F3A4DBC6E8205F1A922A7CE03799BE18B544EDD1F63835E47
F99AC78354CFB99F2B27566721DE55E2F2CFAF564B2D5E41247AC4807ACE083ACBE49EC9
4C068832C32C9A4DA48482080A092485A4000A884005ECA402A898417EC5A4A88E881ECF
AC8E8B2C8FAD248F2C400F64E407443C43D65DE5D64B2CB6412490448001260800816480
48A40820D8449261A60016C9600A082605A491628801A76C80C9C088687C4CB2B9E29277
6F601CC1460FACB7672C90C5E4816EAC08A1BCC4DAC5AE20CE8DF26BAE26136DF1688027
A2C811AB4889CF10CC7B796AFA0B23D2A523D478C3D77BEDD6CA4836098098645845B469
A681724928AE0006DDE003032E01B1A5E0C3C8AE6DD8DDD031E3351BEFA9DC492E73E005
DECE02B28BE1726D4EAE1073BDE93EE52A0C9CC7A687AFA92BAD2E076C45E3C400000000
000000003FFFFFFC000001C00000FC000071C0003FFC001C01C00FC0FC071C71C3FFFFFF
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C006DC1C0303CFC1B1DB1CC3F03FADC71C2C3FFFD4DC001723C00AE3DC05DFD3C2B214DD
722B236E372381F8E3F8E3FFC3FFC01DC01C0F3C0FC76DC71FC03FFE1C1C00EFCFC0791B
1C3B1C3FDE3FDC12FC13C851C8D8ADF8E1DC23FEF3D3C096D4DC420723E523E3CCC3CFDA
ADDB10FC303971DB1F2FF03E65071CD4D3FFA724C029E02C166E14CA51EB298DEB265E2B
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D3EC3FE4C8DC0C28E3C6D6FFDF0610127369081E82148EA92B0FBE073724E3E8E03FCAFE
1C19D0EFC75791A6DEB1C902B3F81172C389AE4DFC4DC221E23D32EF3D4A596D7189206
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F01A84C70CEA2FF6BBB5043661D25856F409AE15444DEBF6622B445737166EE8FA519AF2
8DD4D66E372651F8E14DE3FEB22FC0B2351C5239DFEC3F7208DC4E24E3E3F03FCFC71C1B
1FFFCC3E001ADCE00CC3BE06ADE4E33C2C3FADD4DC2C3723D4D8E3D721FFD6E2E0161F5E
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18F59EBDF596B5259231C0903BFC411E41E49EC4EC068E38C32FFFEDA5000808D00484E5
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D54AAB555B552B52B56DB6DB4AAAABB55555CB555513B555724B5544ABB55CB5CB51
3B13B724924A4AAAAB2B55558DB55534AB5563B5B54D4B2B58DB8DB34AD4A83B6DB434AA
ABF3B555EC4B55024BB57BABCBA40C5F3BEC40C4E24EC495A924A924AAB4AAB55BB55B52C
B52B6E3B6DAB54AAA5B5B5522B2B569D8DB48DB4ABA4ABB5C2B5CB17DB13903A925BB44A
A2CBCB51E3F3B7456C4A7C4A4B334B2B803B8DD2B4D49EDB8DAC2AD4A67D6DB3F3CAA86C
73541A5435E625F307DA0C193A0C67A40C5F02EC40DBF24ECAECA9237234A92493B4AAAA
4BB5552BCB556DF3B54A8C4B5B444BB2BCCBC8DF03F248DB6CAA4AAA352B55136DB5722A
AB449D55BCADD52F369D6FC28DCBB7C493CA34AA7313B534124B63E2ABAD65D5C6CE1D15
A145F1201C0D28A56CEC724A1254AB02A5B59BD22B3EFE9D863A0DB1D40CA95DEC349182
73AB73B445A44BCC22CBF079E3ED91C562BB544DDCB5C8993B126FA492BB82AADCD3D569
0E7D48BD73DA7FC47A32B4D010DB8FA3CAD581736D32042AE088FD74E65BC797E2F51825
FF773A0AE6440F77ECEDE6221287D982C13BF3E624EC67DA925F3A4AA0C42B50C4FDB7C4
9BAA34AEC513B724724A4AD4AB2B6DB58DAAAB34A55583B2553348A5603A724CB434A83B
F3B434EC4BF3924BEC5AABE24255E5AFA506278279DB13B1DA92495A4AAA922B554A9DB5
5B4DAB52B8A5B6DD722AA9C49D54D4ADD58DB69D34AA8DE3B544854B5CA05BB13082C921
E3E2A84565D40C4E1DEC4945824A9C33AB4D7045B8C58C2D44347EDCF3D2291C7E9CB552
0D3B568CE4B48416BBA0E09CC0D4ED06CD92F9A0BAF9E0FC79C4DB51D48AB75DA75A71A3

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72356124934C2AAA387D551513D571727D4504B3DC78B879517D119703F3785B6C2102AA
783BD53134FD61239BCC295EF07C903D932BB7BA0DCA0C0C930C6C2A1C5A7D07FBFFBFFD
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DBDBFFFAFBFFFD2DBFFEBBFBFF49BDBFAFBAFBD2D92DABBEF9B09B6DB8BFF829BFFC6
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829B39F69BD09BDBAABBAF900992CEFBFAFB46D92DE8FEFBD50F6DA828BFF1692BF85DF8B
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BFF6C29BFBF29BDB99B9AF8AB8B2C2082DB2DB6BFBFBFFCBEFBFE6B6DBF2CFFFB9B4FFD8
BECFEE2B74F608F2CB9B09B68BCBBFD2A69BEB86DBB484FF9EF5CFC96A44E7DC79C26C04
82EF3DF6A692DBC6DFBFA0FDDBD58ECFA86074D149C2DA4F82BF7CC68BB650D29FB29B99
DD9B8A8CEB82114486D649F4F9BF9ACCBBCB3569A6D61DB6F990FFECAE8FF76250FB38F2
8DD00991CAFBAE062D921C8BEFD072B6EAC18FE43320F3A55D891704E3E50DC03329C3E5
59823306A6C54CC6F10D50E86982854DA6950DF6DC29DBFC298FBE29A0DB09B59FCBBE69
E69B2D92DBDBEFBFAFB6DBD2DFFFABBDFFD09ADFEABB3DF409D2DABB8BBF09829B8BA69B
8296DB869DFF84D8DFC5DE1DE14D10D14DA69A4DF6DB7DDBFFF6CFBFFBF4DBFDBADFBF9
3DDB6CF2CFFF49B4FFFAFBECFD2DB74EBBFF28C49BF9B1FBBCBC1D9A6A30EB6C4484FF19F5
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A0F46C958A8F7C6210B608D6AF9B19C2CBC282B6A2968FC49DD0E1DFFFFFFF9999999999999999
E0000001FFFFFF1FFFFFF81FFFC71FFFE001FFF1FF1FF81F81FC71C71E0000011FFFFFF61
FFFFB91FFFD8E1FFEE011FF61F61FB91B91D8E38E0E0000181FFFF271FFF9E01FFC91F1F
E7E181F2712719E07E0291C71E9E0001591FFF46E1FFA8E11FD10161EA6F59146EA6E48E
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7E34712706807E0CD7C719596002C6D9FEB0FE9F4C8F59AD70A6B390A6CD0EA6F5A846EA
7158E460460389D89E038E391E0000E11FFF8161FFC7591FE026E1F1EEE11816616275A9
58E271C600E0009F81FFB9C71FD88001EE37FF16077F859C37C56827611D6E39609E00D9
B91F9EB8E1C9480107CF7F6C64B7BF0BEF5B8AB6A7820FC646D8E0B8FE01A80F1F317881
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