Test Patterns for Inner FEC(s)

- Clause 177, 184 and Annex 174A

Comment # 9, 10, 128, 148, 149, 150, 345

Xiang He, Huawei

Background

- There are generally two types of test patterns in P802.3dj:
  - Those used to verify functionality of the logic, like scrambled zeros, scrambled idles, PRBS31, etc.
    - Transmit side (logic) sends known pattern and received side (logic) checks for expected behavior, with the ability to check for bit errors.
  - Those used to test a PAM4 PMD, like PRBS31Q, SSPRQ, etc.
    - PRBS patterns mapped to PAM4 symbols are applied to PAM4 encoders.

Test pattern related comments against Clause 177

Cl **177**	*SC* **177.4**	*P* **332**	*L* **26**	# 10

Brown, Matt — Alphawave Semi

Comment Type **T** *Comment Status* **X**

In order to properly test the performance of an optical link for PMD that uses the Inner FEC a PRBS31 test pattern with Inner FEC encoding is required. The generator and checker may be defined in the Inner FEC sublayer or in the PMA sublayer above the Inner FEC.

SuggestedRemedy

At the input to the convolutional interleaver on the transmit path add the ability to insert a PRBS31 (not PRBS31Q) test pattern and at the output of the convolutional deinterleaver on the receive path add the ability to check a PRBS31 pattern. If the PRBS31 checker is defined in the Inner FEC sublayer then the block error counters as defined in 176.7.4.1 will also need to be added. Alternately source and terminate the PRBS31 pattern on the PMA above the Inner FEC; PRBS31 will need to be added (in addition to PRBS31Q).

- PRBS patterns from PMA above, or at convolutional interleaver input, to test functionality of Inner FEC and PMD.

Cl **174A**	*SC* **174A.6.1.1**	*P* **663**	*L* **39**	# 128

Slavick, Jeff — Broadcom

Comment Type **T** *Comment Status* **X**

The Cl177 and Cl184 Inner FEC blocks are both reliant upon finding the AMs in the data stream to determine the RS-FEC CW boundary. So Figure 174A-2 is not a viable configuration unless that alignment and deskew processes are disabled in a test mode.

SuggestedRemedy

Add a test_mode to Cl177 and Cl184 that causes the input to permutation function in Cl184 and the input to convolutional interleaver in Cl177 to use the PMA service interface input data directly.

- When in “test mode”, “alignment lock and deskew” is disabled and bypassed.

Cl **177**	*SC* **177.5.1**	*P* **338**	*L* **27**	# 9

Brown, Matt — Alphawave Semi

Comment Type **T** *Comment Status* **X**

In Draft 1.3, PRBS13Q and PRBS31Q generators were added to the Inner FEC transmit path output (see 177.4.9). A checker on the input of the receive path would be helpful for rudimentary testing of a PMD or link.

SuggestedRemedy

Add PRBS13Q and PRBS31Q pattern checkers to the input of the Inner FEC receive path.

Cl **177**	*SC* **177.1.4**	*P* **307**	*L* **31**	# 148

He, Xiang — Huawei

Comment Type **TR** *Comment Status* **X**

There should be some test patter checker on the receive path.
A contribution will be provided to support this with block diagrams.

SuggestedRemedy

Add "test pattern check" on the receive path on the PAM4 decode box, similar as in Figure 176-2.

- Add PRBS checker on the Rx

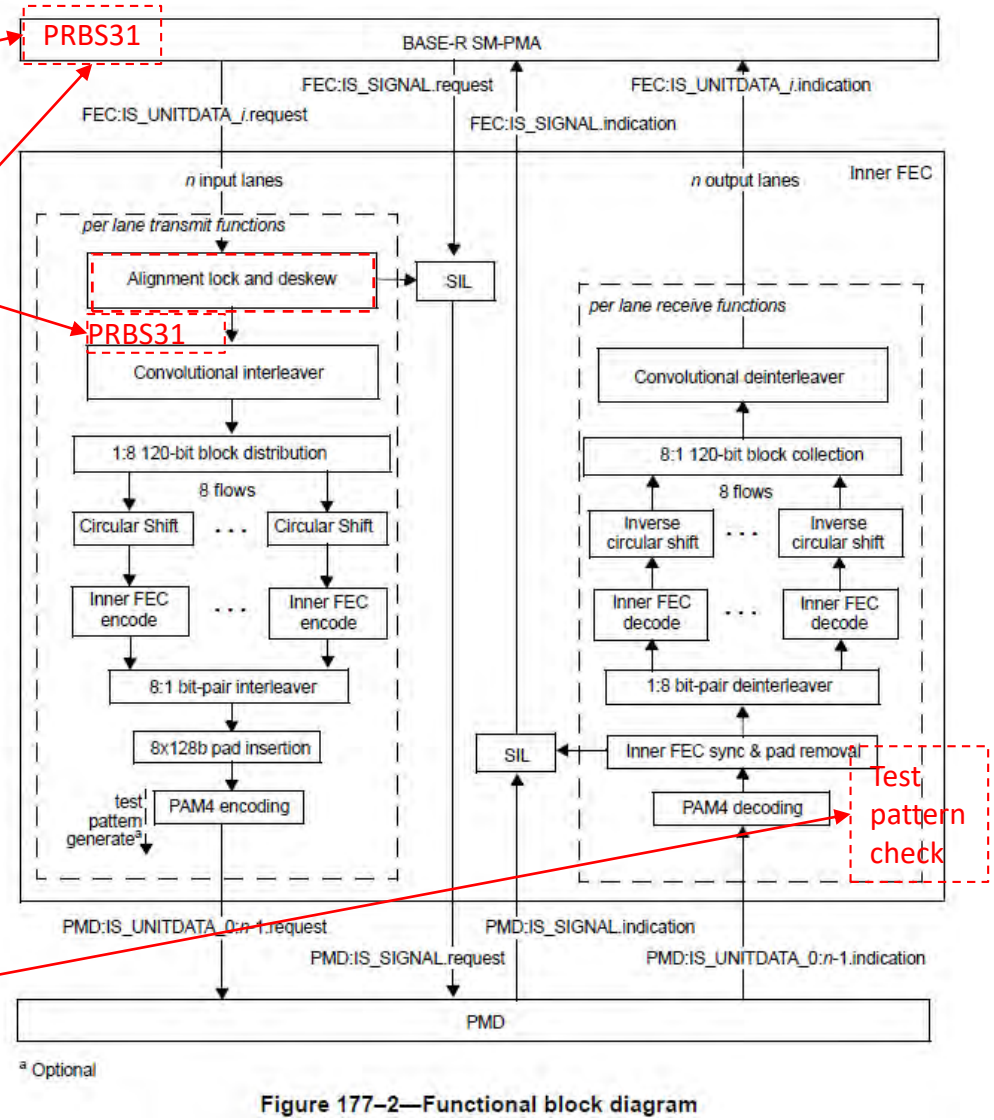


Figure 177–2—Functional block diagram

Test pattern related comments against Clause 184

Cl **184**	*SC* **184.2**	*P* **517**	*L* **34**	# 149
He, Xiang		Huawei		

Comment Type **T** *Comment Status* **X**

Clause 814 Inner FEC for 800GBASE-LR1 did not include any test patterns.

SuggestedRemedy

It is recommed to add at least one test pattern for this clause. Add "Test patter generate" to the DP-16QAM mapper box. Also insert a subclause in 184.4.11 describing the test pattern(s).

Table 185–10—Test patterns

Pattern	Pattern description	Defined in
5	Scrambled idle test pattern encoded by the 800GBASE-LR1 Inner FEC	172.2.4.11, 184.4
7	Valid 800GBASE-R signal encoded by the 800GBASE-LR1 Inner FEC	184.4

- Table 185-10 listed test patterns for Clause 184, but no test patterns were in clause 184.
- Recommend to add a PRBS31 test pattern to test the logic functions.

Cl **174A**	*SC* **174A.6.1.1**	*P* **663**	*L* **39**	# 128
Slavick, Jeff		Broadcom		

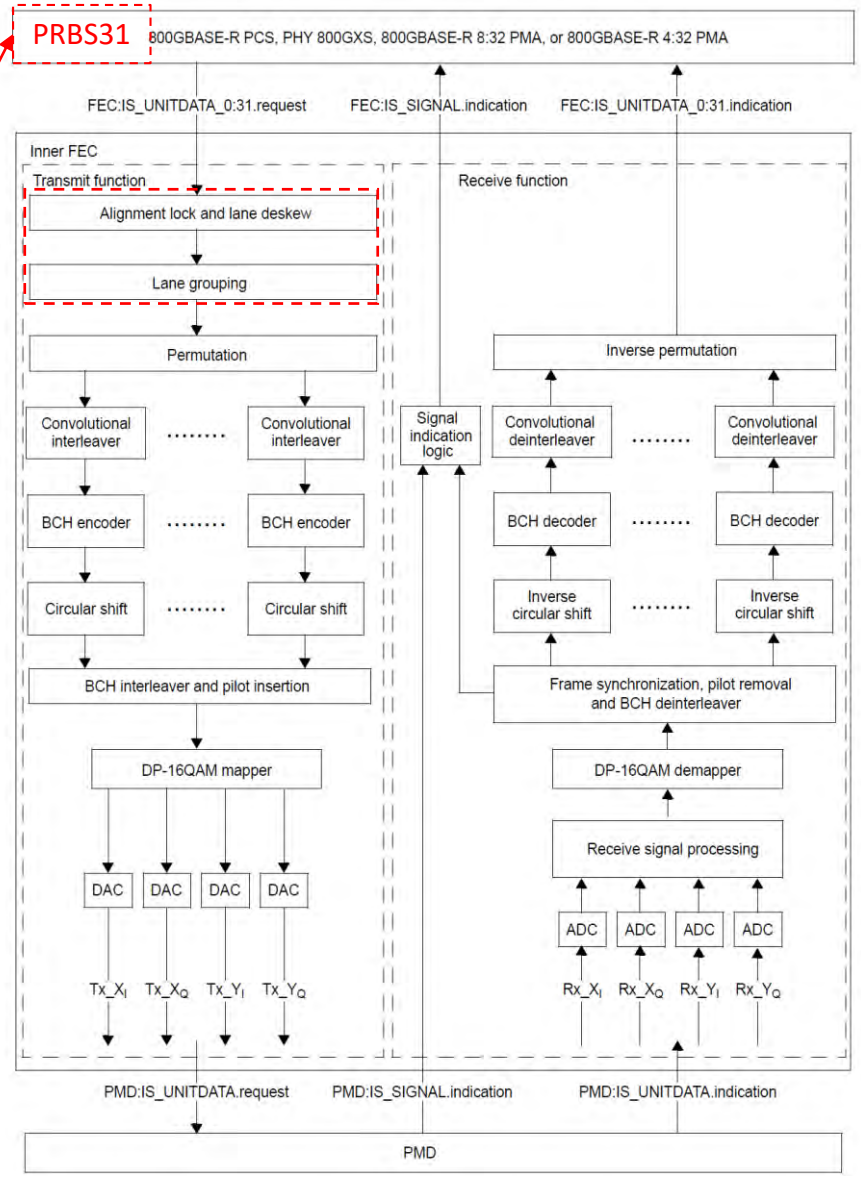
Comment Type **T** *Comment Status* **X**

The Cl177 and Cl184 Inner FEC blocks are both reliant upon finding the AMs in the data stream to determine the RS-FEC CW boundary. So Figure 174A-2 is not a viable configuration unless that alignment and deskew processes are disabled in a test mode.

SuggestedRemedy

Add a test_mode to Cl177 and Cl184 that causes the input to permutation function in Cl184 and the input to convolutional interleaver in Cl177 to use the PMA service interface input data directly.

- When in test mode, “alignment lock and lane deskew” and “lane grouping” are disabled and bypassed.



Test pattern related comments on other clauses

Cl **182**	*SC* **182.9.1**	*P* **481**	*L* **9**	# 345

Ran, Adee — Cisco

Comment Type **TR** *Comment Status* **X**

Pattern 3 as defined in 177.4.9.2 is PRBS31Q without the inner FEC encoding. In contrast, Pattern 5 us defined to include the Inner FEC encoding.

Table 182-17 says RS and SRS can be tested with either pattern 3 or pattern 5.

To measure the block error ratio in either of these tests, the Inner FEC encoding is required. This cannot be achieved for per-lane testing with the current test pattern definition.

Note that measuring the pre-FEC BER with PRBS31Q (without inner FEC encoding) may seem like a desirable test, but this cannot be the normative requirement, since it does not account for correlated errors that the PMD's receiver can cause.

SuggestedRemedy

Either redefine pattern 3 in 177.4.9.2 to include the inner FEC encoding, or change the reference to the PMA's PRBS31Q and specify that the Inner FEC has to be able to add inner FEC encoding to this signal.

- Comment #345 is against Clause 182, but suggested remedy is written for clause 177. This can be resolved using response to comment #10.

Cl **174A**	*SC* **174A.6.1.1**	*P* **663**	*L* **43**	# 150

He, Xiang — Huawei

Comment Type **TR** *Comment Status* **X**

The PAM4 encoder should not be in front of the Inner FEC transmit function.
The PRBS31Q patter should not go through the Inner FEC transmit function in order to maintain its characteristics.
A presentation will be provided.

SuggestedRemedy

First, remove "PAM4 encoder" box. Then, either change "PRBS31Q" to "PRBS31", or move "PRBS31Q" into the "Inner FEC transmit function" box.
A presentation will be provided.

- Comment #150 is essentially the same thing as comment #10 but focused on the diagram in 174A.

Suggested changes for Clause 177

- A PRBS31 test pattern may be optionally generated and detected in the PMA above (colocated PMA).
  - Dedicated PRBS31 generator per PMAL. No special requirement on seeds.
  - “Alignment lock and deskew” is disabled and bypassed when in test mode.

- Proposed text changes: (#10, #128)

Insert following subclause before 177.4.9.1:

177.4.9.1 PRBS31 encoded by Inner FEC

The Inner FEC may optionally support a test mode, where a PRBS31 test pattern generated from each PMA lane above (see 176.7.4) is processed by Inner FEC sublayer, with the exception that the alignment lock and deskew function on the transmit path (see 177.4.1) is disabled and bypassed. On the receive path, the PMA above may detect the PRBS31 pattern recovered by the Inner FEC sublayer.

Insert following subclause before 177.5.1:

177.5.1 Test pattern checkers:

The Inner FEC may optionally include test pattern checkers for PRBS13Q and PRBS31Q (see Figure 177-2). Hard-decision PAM4 decoding results are used for test pattern checkers.

- Proposed changes to Figure 177-2: (#9, #148)

Suggested changes for Clause 184

- A PRBS31 test pattern may be optionally generated and detected in the PMA above (colocated PMA).
  - Since there is only one PMD lane, there is no need to provide PMAL based test patterns.
  - “Alignment lock and lane deskew” and “lane grouping” are disabled and bypassed when in test mode.

- Proposed text to add a PRBS31 test pattern:

184.4.12 Inner FEC test patterns

184.4.12.1 PRBS31 encoded by Inner FEC

The Inner FEC may optionally support a test mode, where a PRBS31 test pattern generated from the PMA above (see 176.7.4) is round-robin distributed to pcsla[q] for q=0 to 31, and then processed by Inner FEC sublayer, with the exception that the “alignment lock and lane deskew” (see 184.4.1) and “lane grouping” (see 184.4.2) functions on the transmit path are disabled and bypassed. On the receive path, the PMA above may detect the PRBS31 pattern recovered by the Inner FEC sublayer.

Suggested remedies for comment #128, 150

- Change PRBS31Q to PRBS31.
- Remove the “PAM4 encoder” box in the test source.
- In 177.4.2 add this paragraph after the first paragraph:

  When in test mode the convolutional interleaver uses the Inner FEC service interface inputs directly. The selection of the 40-bit symbol boundary point is implementation specific.

- In 184.4.2 add this paragraph at the end:

  When in test mode the data received on each of the Inner FEC service interface inputs (FEC:IS_UNITDATA_0:31.request) is mapped to pcsla[q] for q=0 to 31.

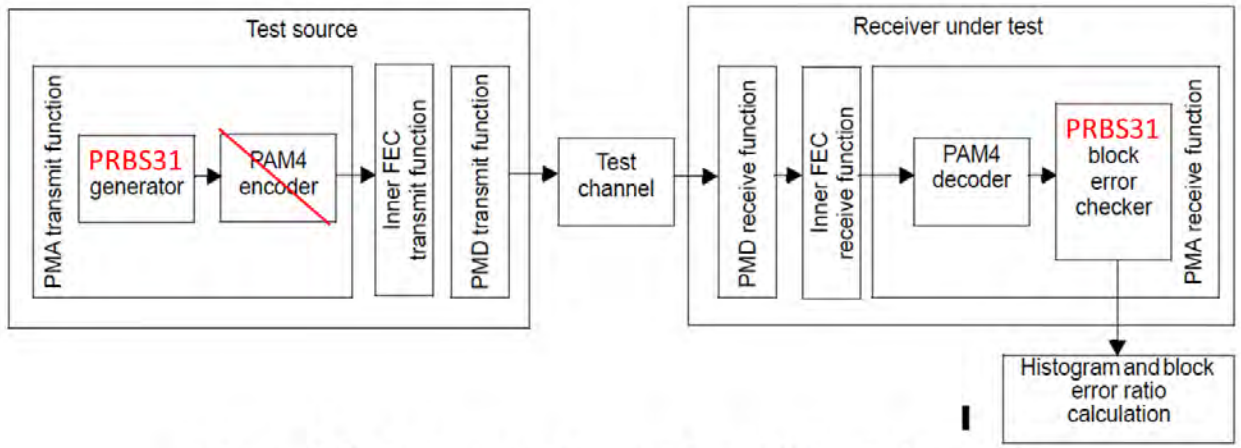


Figure 174A–2—Test configuration for a PMD with Inner FEC

Thank you!