ITU - Telecommunication Standardization Sector

STUDY GROUP 15

Original: English

Antwerp, Belgium – 18 – 22 June 2012

Question: 4/15

SOURCE[1]:   TNO

TITLE: G.fast: Specification of the wire pair models T05b and T05h

ABSTRACT

The TNO cable model has been refined by the addition of the q_c parameter to fit better the properties of cables with high-loss dielectrics. This contribution argues that this parameter can be set to zero for the wire pair models CAT5, T05u, T05b and T05h. This means that there is no need to change the agreed models for CAT5 and T05u. In addition, we propose to define the wire pair models T05b and T05h using the parameter values proposed in 2012-02-4A-030 (and earlier contributions), with the new parameter q_c set to zero.

1. Introduction

At the May 2012 meeting, a refinement [4] to the TNO cable model for G.fast was agreed, introducing an extra parameter (q_c) in the admittance Y_p of the model to improve the match of cables where the dielectric loss cannot be ignored. If the q_c parameter is set to zero, the newly agreed model reduces to the original model proposed in [1][2][3].

As a result of this agreement, the provisional agreement (issue 4.7.2.1.7) to adopt the cable type parameter model and values proposed in §4 of 2012-02-4A-030 [3] was reversed to "closed". In parallel, the editor's document 2012-5-4A-060 [5] has captured most of the agreements so far on reference loops and wire pair models, including the agreements to add the new wire types "T05b" and "T05h".

However, the model and the parameter values for these two wire types T05b and T05h have not been fixed yet in 2012-5-4A-060, because of:
- The reversal on issue 4.7.2.1.7.
- The question of the group whether a non-zero value of the new parameter q_c is needed to model the proposed wire pair types, or whether it can be set equal to zero.

2. No modifications for the wire pair models CAT5, T05u, T05b and T05h

TNO has investigated to use of the new q_c parameter for all the four cable types CAT5, T05u, T05b and T05h [4], and found that there is no need to use a non-zero value of the q_c parameter for these cables. The extra parameter q_c serves to model the frequency dependence of the loss-angle of the admittance Y_p. In the four cables investigated by TNO the loss-angle is so small that any frequency dependence of it is considered to be irrelevant.

Therefore, the use of the additional parameter q_c for these four cables is unnecessary, and it can be set equal to zero. This means that there is no need to change the agreed models for CAT5 and T05u. In addition, we propose to define the

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wire pair models T05b and T05h using the parameter values proposed in 2012-02-4A-030 (and earlier contributions), with the new parameter q_c set to zero.

3. Proposed additions to the text on reference loops and wire pair models

The text below is proposed for section 2.4.2 of the text on reference loops and wire pair models (latest version in 2012-05-4A-060). For ease of reference, the changes with respect to 2012-05-4A-060 are shown as tracked changes. Note that the formula for Y_p in Table 6 below has been modified and now includes the parameter q_c (this is not shown by the tracked changes).

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2.4.2 Cable model for wiring types CAT5, and T05u, T05b and T05h

The parameterized model for the wire types CAT5, and T05u, T05b and T05h is defined in Table 6. The parameter values for these wire types are defined in Table 7.

Table 6 – Parameterized model for wire types CAT5, and T05u, T05b and T05h.

$$[Z_s, Y_p] = \text{Model} (Z_{0\infty}, \eta_{VF}, R_{s0}, q_L, q_H, q_c, q_x, q_y, f, f_d)$$

$$Z_s(jw) = jw \cdot L_{s\infty} + R_{s0} \times \left(1 - q_s \cdot q_x + sqrt\left(q_s^2 \cdot q_x^2 + 2 \cdot \frac{jw}{w_s} \cdot \left(\frac{q_s^2 + jw/w_s \cdot q_y}{q_s^2/q_x + jw/w_s \cdot q_y} \right) \right) \right)$$

$$Y_p(jw) = jw \cdot C_{p0} \times (1 - q_c) \times \left(1 + \frac{jw}{w_d} \right)^{-2 \cdot f/p} + jw \cdot C_{p0} \times q_c$$

$L_{s\infty} = \dfrac{1}{h_{VF} \cdot c_0} \times Z_{0\infty}$	$c_0 = 3 \cdot 10^8$ [m/s]
$C_{p0} = \dfrac{1}{h_{VF} \cdot c_0} \times \dfrac{1}{Z_{0\infty}}$	$m_0 = 4\pi \cdot 10^{-7}$ [H/m].
$q_s = \dfrac{1}{q_H^2 \cdot q_L}$	
$w_s = q_H^2 \cdot w_{s0} = q_H^2 \cdot \left(\dfrac{4p \cdot R_{s0}}{m_0} \right)$	
$w_d = 2p \cdot f_d$	

Table 7 – Parameter values for wire types CAT5, ~~and~~ T05u, T05b and T05h.~~

Cable type	Parameters of reference model
CAT5	$Z_{0\infty} = 98.000000$ $\eta_{VF} = 0.690464$ $R_{s0} = 165.900000e\text{-}3$ $q_L = 2.150000$ $q_H = 0.859450$ $q_x = 0.500000$ $q_y = 0.722636$ $q_c = 0$ $f = 0.973846e\text{-}3$ $f_d = 1.000000;$
T05u	$Z_{0\infty} = 125.636455$ $\eta_{VF} = 0.729623$ $R_{s0} = 180.000000e\text{-}3$ $q_L = 1.666050$ $q_H = 0.740000$ $q_x = 0.848761$ $q_y = 1.207166$ $q_c = 0$ $f = 1.762056e\text{-}3$ $f_d = 1.000000$
T05b	$Z_{0\infty} = 132.348256$ $\eta_{VF} = 0.675449$ $R_{s0} = 170.500000e\text{-}3$ $q_L = 1.789725$ $q_H = 0.725776$ $q_x = 0.799306$ $q_y = 1.030832$ $q_c = 0$ $f = 0.005222e\text{-}3$ $f_d = 1.000000$
T05h	$Z_{0\infty} = 98.369783$ $\eta_{VF} = 0.681182$ $R_{s0} = 170.800000e\text{-}3$ $q_L = 1.700000$ $q_H = 0.650000$ $q_x = 0.777307$ $q_y = 1.500000$ $q_c = 0$ $f = 3.023930e\text{-}3$ $f_d = 1.000000$

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4. Summary

This paper should be presented under the G.fast agenda item, and is related to following existing issues

4.7.2.1.7	Closed	provisionally to adopt the cable type parameter model and values proposed in §4 of 2012-02-4A-030 as working text for wiring topologies and reference loops, subject to there being no contribution(s) to the May 2012 Q4a meeting with alternative proposal(s). • closed as a result of 2012-05-4A-047 being submitted to the meeting	2012-02-4A-030
4.7.2.1.7.1	Agreed 10-May-12	that the cable model for G.fast agreed in issue 5.1.1.1 shall be modified according to 2012-05-4A-047R1, including a third parameter q_c.	2012-05-4A-047R1
4.8	Agreed 12-Sept-11 Revised 7-May-12	To adopt 2012-05-4A-060 as baseline text for wiring topologies and reference loops.	11GS3-100R1, 11RV-071, 2012-05-4A-060

This paper seeks agreement on the following new issue:

	open	Should the model and parameter values in section 3 of 2012-06-4A-036 be adopted for the wire type models T05b and T05h in the text for wiring topologies and reference loops (2012-05-4A-060)	2012-02-4A-030 2012-05-4A-060 2012-06-4A-036

References

[1]   TNO: "G.fast: Wideband modeling of twisted pair cables as two-ports", Contribution ITU-T SG15/Q4a 11GS3-028, Geneva, Switzerland, Sept 2011

[2]   TNO: "G.fast: Parametric cable models for specifying reference loops", Contribution ITU-T SG15/Q4a 11GS3-029, Geneva, Switzerland, Sept 2011

[3]   TNO: "G.fast: Specification of reference loops and wire pair models", Contribution ITU-T SG15/Q4a 2012-02-4A-030, Paris, France March 2012

[4]   Ericsson AB, TNO, "G.fast: Proposed change of admittance in current G.fast cable model", Contribution ITU-T SG15/Q4A 2012-05-4A-047R1, Geneva, Switzerland May 2012

[5]   Editor for G.fast, "G.fast: Wiring topologies and reference loops" Contribution ITU-T SG15/Q4A 2012-05-4A-047R1, Geneva, Switzerland May 2012.