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System Application	Asymmetric Digital Subscriber Line	
Product Type	ISDN/ANALOG Splitter	
Product Name	CPF906G	
Date	Apr. 03 th , 2002	
Issued By	Bert Lin - Design Engineer, R&D_1	
	bert@ycl.com.tw	
Approved By	Roger Wu – Manager, R&D_1	
	Roger@ycl.com.tw	
Issued Date		



YCL Electronics Co., Ltd.

No.95, Feng Jen Road. Feng Shan City, Kaohsiung, Taiwan, R.O.C.

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1. Introduction:

The CPF906G is a splitter module that has been specifically designed to implement the functionality of low pass filter in ISDN/POTS over ADSL application. The CPF906G integrate low pass filter that block the high frequency energy from reaching the ISDN/POTS device and provide isolation from impedance effects of the ISDN/POTS device on ADSL. Because the ISDN/POTS splitter connects directly to the subscriber loop media , it must also provide some protection for externally induced line hits or faults which could damage any attached equipment or endanger humans interacting with the installed equipment. The circuit protection will be provided mostly by standard central office line protection means and additional protection measures built into splitter to protect against line overstress which could damage the splitter itself. This splitter mainly consist of one low pass filter which provide ISDN and POTS solution respectively

2. Reference:

Ref. 1 : ETSI TR 101 728 V1.1.1

Ref. 2 : ETSI TS 101 388 Asymmetric Digital Subscriber Line European specific requirements

Ref. 3 : ANSI T1.413 Network and customer installation interface.

Ref. 4 : ITU G.992.1 Annex B

Ref. 5 : ITU-T K.21 Resistibility of telecommunication switching equipment to Overvoltages and overcurrents .

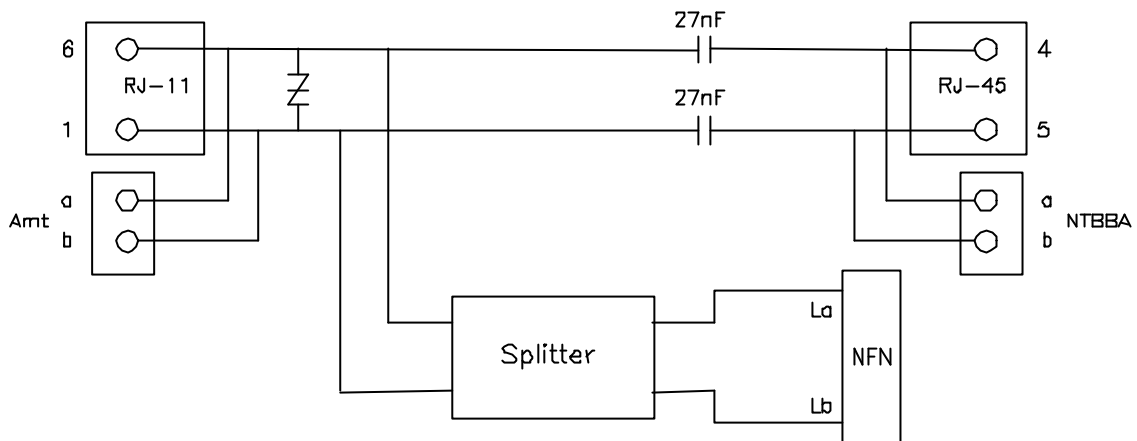
3. Abbreviations:

ADSL	Asymmetric Digital Subscriber Line
ISDN	Integrated Service Digital Network
CO	Central Office
CPE	Customer Premise Equipment.
POTS	Plain Old Telephone Service
RT	Remote Terminal
Z _{ADSL}	Network termination of ADSL

4. Technical requirements:

4.1. Schematic:

The following drawing illustrates the schematic of this product.



4.2. Electrical Specification :

4.2.1. ISDN requirement :

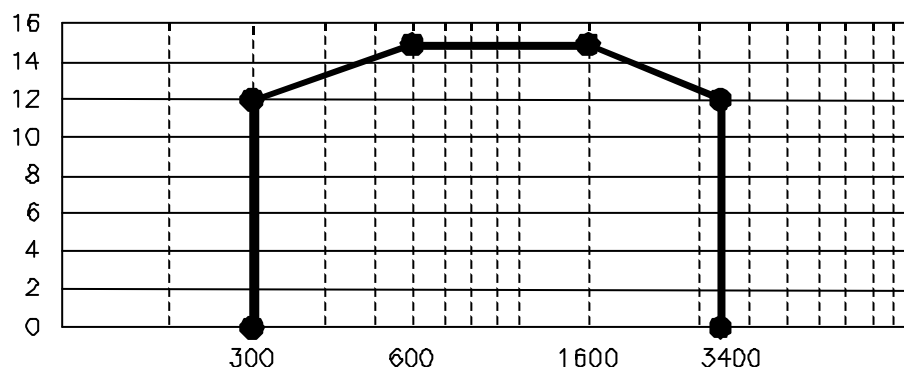
All of electrical specifications for ISDN path stated herein must be met and satisfied separately for single individual splitter and also for the complete splitter combination.

Splitter parameter	Electrical requirements		
	Range	values	
ISDN band(3dB bandwidth)		DC to 94KHz	
ADSL band		160KHz-1104KHz	
Nominal impedance			
Line impedance ZL		150 ohm	
CO impedance ZTc		150 ohm	
RT impedance ZTr		150 ohm	
Modem impedance		100 ohm	
Current voice band			
Loop current		200mA	
DC resistance			
DC resistance		<=12.5 ohm	
Isolation resistance tip/ring		>5 M ohm	
ISDN band characteristic			
Delay distortion	300Hz<f<80KHz	<=20 usec	
Longitudinal balance	300Hz<f<30KHz	>40 dB	
	30KHz<f<1104KHz	>50 dB	
	1104KHz<f<5MHz	>30 dB	
Splitter parameter	Rang	Modem	Value
Insertion Loss	1KHz<f<60KHz	Z _{ADSL}	<1.2dB
	1KHz<f<60KHz	NA	<1.5dB
	60KHz<f<80KHz	Z _{ADSL}	<2.0 dB
	60KHz<f<80KHz	NA	<2.5 dB
Return Loss	1KHz<f<60KHz	Z _{ADSL}	≥16 dB
	1KHz<f<60KHz	NA	≥12 dB
	60KHz<f<80KHz	Z _{ADSL}	≥14 dB
	60KHz<f<80KHz	NA	≥10 dB
Stop Band Attenuation	138KHz<f<150KHz	Z _{ADSL}	>55 dB
	150KHz<f<1104KHz		>65 dB
	1104KHz<f<2208KHz		>55 dB

4.2.2. POTS requirement :

Splitter parameter	Electrical requirements		
	Range	values	
Frequency range			
Splitter bandwidth		DC to 16KHz	
Nominal voice band		0.3KHz to 3.4KHz	
Billing tone		16KHz±80Hz	
Ringing frequency		22Hz to 28Hz	
ADSL band		160KHz to 1104KHz	
Line Impedance ZL		220ohm + (820ohm 115nF)	
CO impedance ZTc		220ohm + (820ohm 115nF)	
RT impedance ZTr		220ohm + (820ohm 115nF)	
Modem impedance	160KHz < f < 1104KHz	100 ohm	
Operation voltage voice band			
Nominal signal		21mVpp to 5.4 Vpp	
Billing tone		10Vpp to 30.2Vpp	
Ringing signal		40Vrms to 80Vrms(113Vpp to 227 Vpp)	
DC voltage		0V to -72V	
Max. AC voltage		70Vrms with -72VDC offset voltage	
Max. differential		190V	
Current voice band			
Loop current		<100mA	
Transient current(on/off hook)		<400mA	
DC Resistance			
DC Resistance		<=12.5 ohm	
Isolation resistance tip/ring		>5 Mohm	
Voice –band characteristic			
Splitter parameter	Rang	Modem	Value
Insertion Loss	300HZ < f < 3.4KHz (Refer to 1KHz)	Z _{ADSL}	<1.0dB
		NA	
	16KHz ± 1KHz	Z _{ADSL}	<3.0dB
		NA	
Return Loss	300KHz < f < 3.4KHz	Z _{ADSL}	See note
Stop band attenuation	138KHz < f < 2208KHz	Z _{ADSL}	>55dB

NOTE:



4.2.3. DC characteristic :

All requirement of this specification can be met in the presence of all ISDN/POTS loop currents from 0mA to 100mA. This ISDN/POTS splitter can pass ISDN/POTS tip-to-ring dc voltages of 0V to 72V and ringing signals of 40V to 80Vrms at any frequency from 22Hz to 28Hz with a dc component in the range from 0V to 72V. The dc resistance from tip-to-ring at the line port interface with the phone interface shorted, shall be less than or equal to 12.5 ohms. The DC resistance from tip-to-ground and from ring-to-ground at the ISDN/POTS interface with the U-R interface open shall be greater than or equal to 5 Megohms. The ground point shall be local building or green wire ground. As an objective , the dc resistance should exceed 10MΩ.

4.3. Test Methodology For ISDN Function:

4.3.1. Filter insertion loss Test :

4.3.1.1. Test Equipment :

- a . HP4395A Network / Spectrum / Impedance Analyzer
- b . HP87512A Transmission / Reflection test set
- c . Balun North Hills : 0415LB(50Ω : 150Ω)

4.3.1.2. Test Setup: is shown in Fig.1

4.3.1.3. Test Procedure :

- a . Set HP4395A in B/R mode for insertion loss test.
- b . Connecting the Analyzer to the ISDN and line side of splitter through the North Hills Balun 0415LB
- c . Set frequency of interest given in specification.
- d . Calibrating the HP4395A network Analyzer via the thru for attenuation test .
- e . Measurement insertion loss.

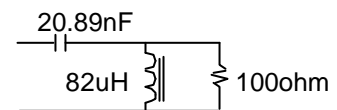
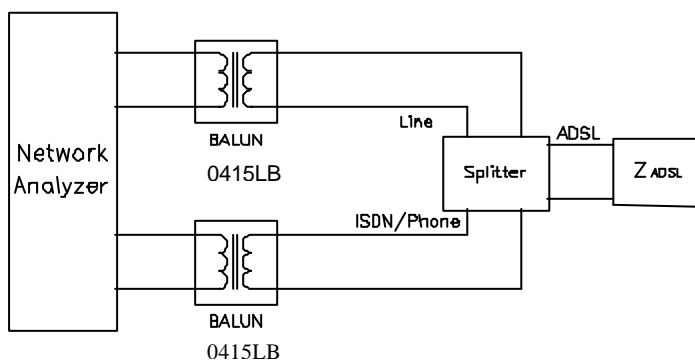


Fig. 1-a. Z_{ADSL} Load

Fig.1. Test Setup

Note : Z_{ADSL} load can be terminated with load, or open

4.3.2. Filter return loss Test :

4.3.2.1 . Test Equipment :

- a. HP4395A Network / Spectrum / Impedance Analyzer
- b. HP87512A Transmission / Reflection test set
- c. Balun North Hills : 0415LB(50Ω : 150Ω)

4.3.2.2 . Test Setup: is shown in Fig. 2

4.3.2.3. Test Procedure :

- a. Set HP4395A in A/R mode.
- b. Connecting the Analyzer to the ISDN/POTS sides of splitter through the North Hills Balun 0415LB. While Z_{ADSL} load can be terminated with load, or open.
- c. Set frequency of interest given in specification.
- d. Calibrating the HP4395A network Analyzer via the open, load calibration being performed for return loss.
- e. Measurement Return Loss.

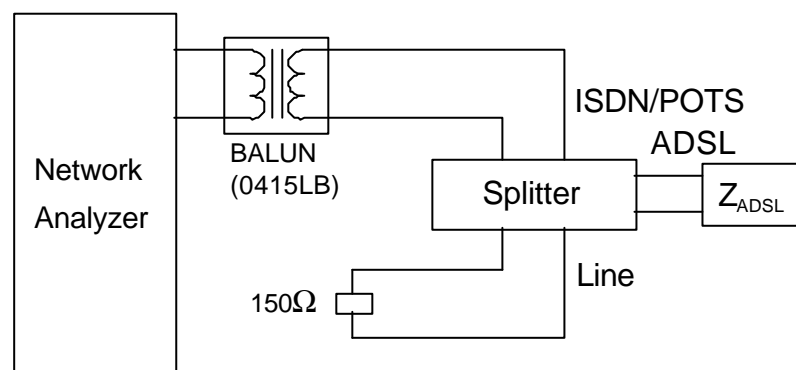


Fig.2 Test Setup

Note : Z_{ADSL} load can be terminated with load, or open

4.3.3. Filter Attenuation Test.

4.3.3.1. Test Equipment :

- a . HP4395A Network / Spectrum / Impedance Analyzer
- b . HP87512A Transmission / Reflection test set
- c . Balun North Hills : 0311LB(50Ω : 100Ω) ;0415LB(50Ω : 150Ω)

4.3.3.2. Test Setup: is shown in Fig. 3

4.3.3.3. Test Procedure :

- a . Set HP4395A in B/R mode for attenuation test.
- b . Connecting the Analyzer to the ISDN and line side of splitter through the North Hills Balun 0311LB(50Ω : 100Ω) ;0415LB(50Ω : 150Ω)
- c . Set frequency of interest given in specification.
- d . Calibrating the HP4395A network Analyzer via the thru for attenuation test .
- e . Measurement attenuation.

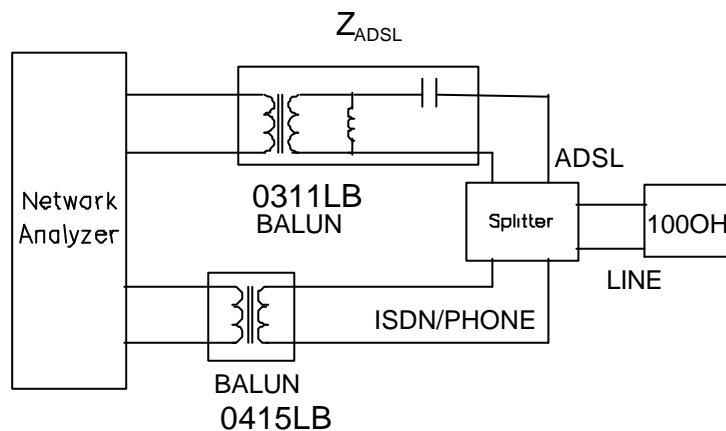


Fig.3 Test Setup

4.4. Test method For POTS Function:

4.4.1. Filter Insertion loss test :

4.4.1.1. Description :

Insertion loss /Attenuation mentioned herein is defined as below :

$$IL = 20 \log_{10} \left| \frac{V_o}{V_i} \right| \text{ dB}$$

V_i = the voltage value measured is shown in Fig. 4

V_o = the voltage value measured across the Line side shown in Fig. 5

4.4.1.2. Apparatus :

- a . Function generator or equivalent
- b . Readout oscilloscope or equivalent.
- c . Complex load $Z_L = 220 \text{ ohm} + 820 \text{ ohm} // 115 \text{ nF}$

4.4.1.3. Test procedure :

- a . Set the measurement Frequency of interest
- b . Connecting the source to the Phone side of splitter with the complex load $Z_L = 220 \text{ ohm} + 820 \text{ ohm} // 115 \text{ nF}$ across the Line side.
- c . Measure the voltage value and calculate the Insertion loss expressed in decibel from the equation Insertion loss = $20 \log_{10} \left| \frac{V_o}{V_i} \right| \text{ dB}$
- d . Change another frequency of interested the repeat step a~d.

4.4.1.4. Insertion loss test set up measurement :

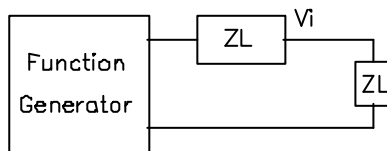


Fig. 4

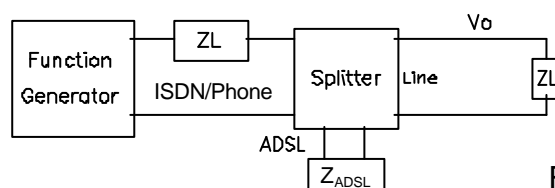


Fig. 5

4.4.2. Filter return loss test :

4.4.2.1. Description :

Return loss is essentially defined as the ratio of the power incident upon a given transmission system to the power reflected caused by an impedance mismatch with respect to reference impedance at the interface between source and device. Return loss is generally expressed in decibels. General Return Loss equation as below:

$$\text{Return loss} = 20 \log \left| \frac{Z_R + Z_M}{Z_R - Z_M} \right| \text{ dB}$$

Z_R = the reference impedance is shown in Fig. 6

Z_M = the measured impedance is shown in Fig. 7

4.4.2.2. Test equipment :

- a : HP 16047A Transformer Test Fixture
- b : HP HP 4192A Analyzer or equivalent
- c : Complex load $Z_L = 220\text{ohm} + j820\text{ohm} // 115\text{nF}$

4.3.2.3. Test setup : is shown in below

4.3.2.4. Test procedure :

- a : Set the measurement Frequency of interest
- b : Calibrating the HP4192A L.C.Z. impedance Analyzer via the short . open, load
- c : Connecting the Analyzer to the Line side of splitter with the complex load $220\text{ohm} + j820\text{ohm} // 115\text{nf}$ across the POTS(ISDN) side. While Z_{ADSL} load can be terminated with Z_{ADSL} load or open.
- d : Measure the impedance value $R + jX$ and calculate the Return loss expressed in decibel from the equation $\text{Return loss} = 20 \log \left| \frac{Z_R + Z_M}{Z_R - Z_M} \right| \text{ dB}$
- e : Change another frequency of interest, then repeat step b~e.

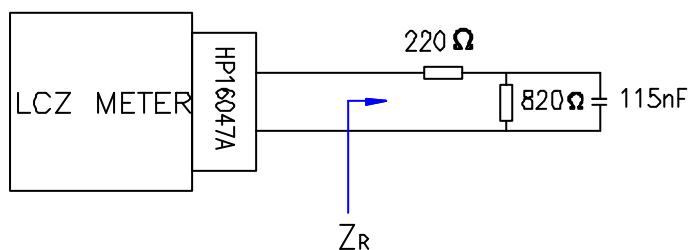


Fig. 6

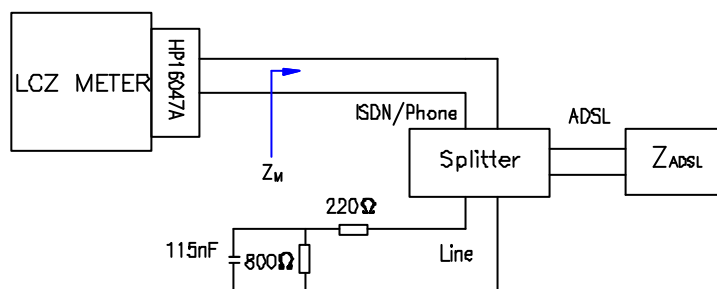


Fig. 7

Note : Z_{ADSL} load can be terminated with Z_{ADSL} load or open

4.4.3. Filter attenuation test :

4.4.3.1. Test equipment :

- a. HP4395A Network / Spectrum / Impedance Analyzer
- b. HP87512A Transmission / Reflection test set
- c. Balun North Hills : 0311LB(50Ω : 100Ω);0511LB(50Ω : 150Ω)

4.4.3.2. Test setup: is shown in Fig. 8

4.4.3.3. Test procedure :

- a. Set HP4395A in B/R mode.
- b. Connecting the Analyzer to the ISDN/POTS and ADSL side of splitter through the North Hills 0311LB and 0511LB(50Ω : 150Ω).
- c. Set frequency of interest given in specification.
- d. Calibrating the HP4395A network Analyzer via the thru.
- e. Measurement attenuation.

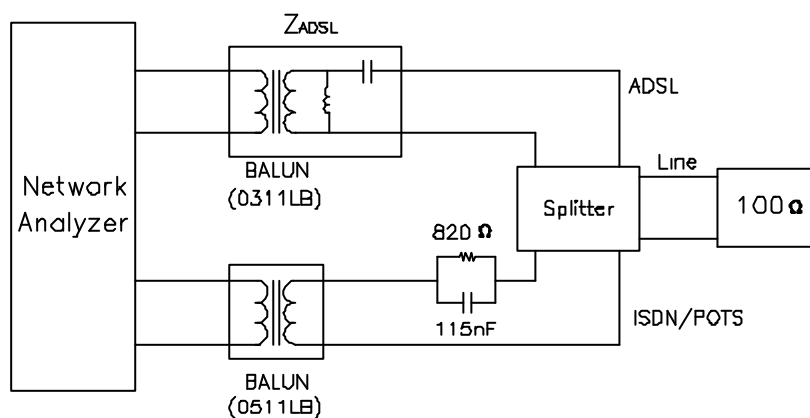


Fig. 8

5. Environmental condition:

5.1. Resistibility to overvoltages and overcurrents:

The splitter has to comply with requirements as per ITU-T K.21.

5.2. Climatic conditions:

5.2.1. Operating temperature:

Application indoor
Long time operation guarantee temperature (5 to 40 °C)
Short time operation guarantee temperature (0 to 50 °C)
(According to ETS 300 019, class 3.2)

5.2.2. Storage and transport:

Low ambient temperature - 20 °C
High ambient temperature +85 °C
(According to MIL-STD-202 method 107 / QC-0-20)

5.2.3. Operation humidity:

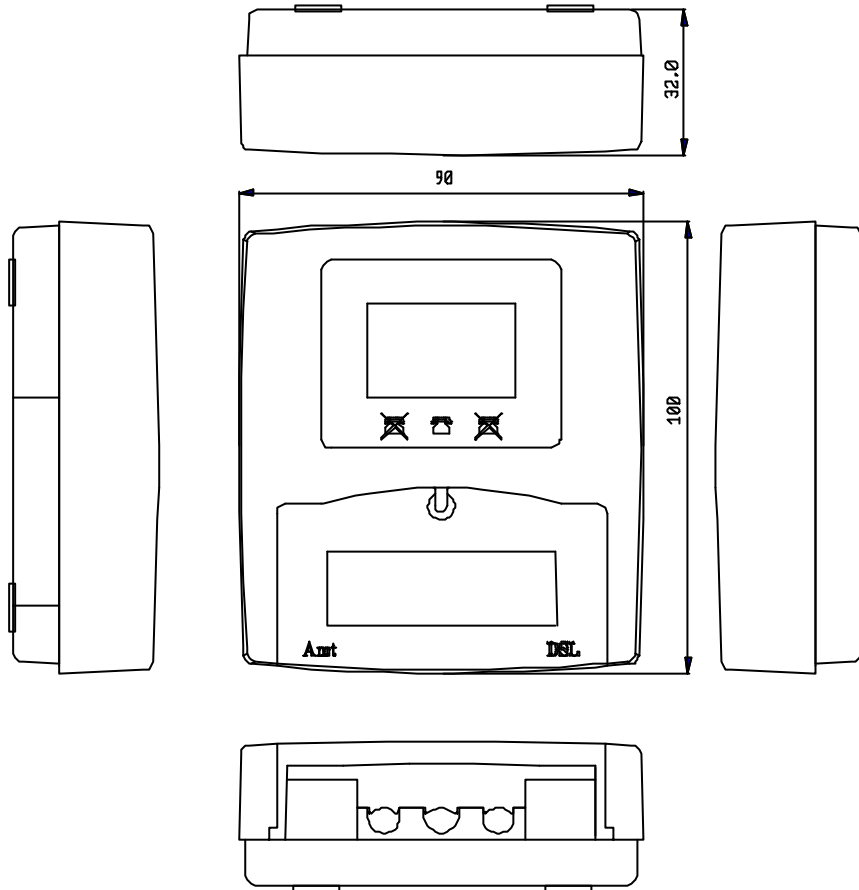
Long time operation guarantee humidity (5 to 85 %)
Short time operation guarantee humidity (5 to 90 %)
Short time : within 72 continuous hours and 15 days in a year

6. Reliability conditions:

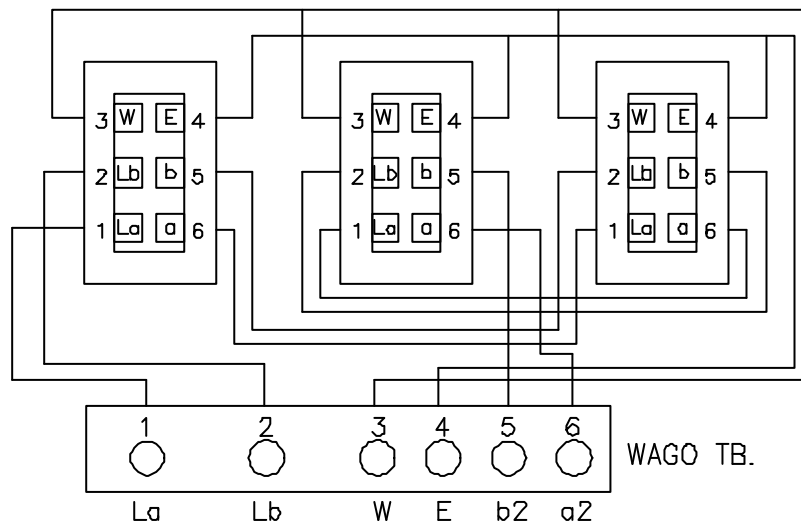
Test Item	Description of Testing	Test Condition	Acceptance	Sampling Quantities	
				D.V.T. Pilot Run	Mass Product
1	Visual/Mechanical Examination	By Visual Examination or by using X-Ray , Microscope etc. to Examine sample.	No cracking , broken , marking color changing and lose marking after washing.	2	4
		Reference:QC-0-12&QC-0-22			
2	Electrical Characteristic	According to clause 4.5 Electrical Specification , pp. 16-17.	No electrical failure.	2	4
		Reference: QC-0-16			
3	Thermal Shock	-20 °C +85 °C , for 5 cycles.	No electrical failure.	1	2
		Reference: MIL-STD-202 method 107 / QC-0-20			
4	Temperature Humidity Exposure	+50 °C / 95 RH , 96 hrs.	No electrical failure.	1	2
		Reference: MIL-STD-202 method 103 / QC-0-11			
5	Vibration Test	Random vibration / Freq. : 5 ~ 500 Hz / Sweep time : 1 hr. / axis / Force : 2.4 grams	No electrical failure & mechanical faults.	1 box	1 box
		Reference: MIL-STD-202 method 204 / QC-0-21			

7. Mechanical condition:

7.1. PCB dimension :

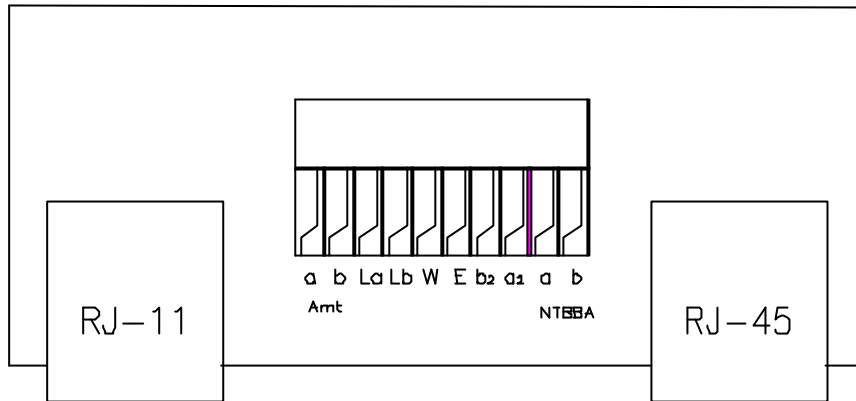


7.2. NFN connector :



7.3. Accessible connector marking :

The following drawing is describing the splitter connector panel.
All marks are to be placed on the PCB components side.



7.4. Connector and pin assignment :

RJ11 connector

Pin	Signal
1	b
2	NC
3	NC
4	NC
5	NC
6	a

RJ45 connector

Pin	Signal
1	NC
2	NC
3	NC
4	ADSLa
5	ADSLb
6	NC
7	NC
8	NC