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System Application	Micro Filter For ADSL CPE Side	
Product Type	POTS Splitter	
Product Name	MF609A	
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Table of contents

<u>Item</u>	<u>Description</u>	<u>Page</u>
1.	Introduction	3
2.	Reference	3
3.	Abbreviations	4
4.	Technical requirements	4
4.1.	Schematic	4
4.2.	ZHP-r definition	4
4.3.	Electrical specification	5
4.4.	DC characteristic	7
4.5.1.	On hook insertion loss	7
4.5.2 .	Off hook insertion loss	8
4.5.3 .	Return loss	9
4.5.3.1.	Phone port return loss	9
4.5.3.2.	Line port return loss	9
5.	Environmental condition	10
5.1.	EMC surge and power contact	10
5.2.	Climatic condition	10
5.2.1.	Operating temperature	10
5.2.2.	Storage and transport	10
6.	Reliability condition	11
6.1.	Operation	11
6.2.	Handling	11
6.3.	Storage and transport	11
6.4.	product safety	11
7.	Mechanical condition	12

1. Introduction:

The in-Line Micro filter has been specifically designed to implement the functionality of low pass filter in G.Lite system. G.Lite technology is similar to full rate ADSL in using DMT technology but operates at a lower data rate of up to 1.5Mbps downstream and 512Kbps upstream, depending on line conditions and lengths.

ADSL Lite is proposed as a lower speed version of ADSL that will eliminate the need for telecom to install and maintain a premises based POTS splitter. Recent field trials of DSL Lite equipment jointly carried out by a group of manufacturers and a North America network operator has proved the technology, achieving maximum data rate for distance up to 15000 feet. It was found necessary to include one or more low pass filters in series with the POTS terminals in order to reliably achieve maximum data rates. For POTS voice band service, the low pass filter provide protection from ADSL signal which may impact through non-line or other effects remote devices(handset, fax, voice band modem etc)and central office operation. For ADSL signal, it also provide protection from the high frequency transient and impedance effect that occur during POTS operation(ringing transients, on-hook, off-hook transient and so on).

Because the 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 pots splitter to protect against line overstress which could damage the splitter itself.

2. Reference:

- | | |
|---|--|
| Ref. 1 : ETS 300 001 | Attachment to Public Switched Telephone Network |
| Ref. 2 : ANSI T1E1.4 In-Line
Filter standard | Network and Customer Installation Interface |
| Ref. 3 : ITU-T K21 | Resistibility of subscribers terminal to overvoltage and
overcurrents |

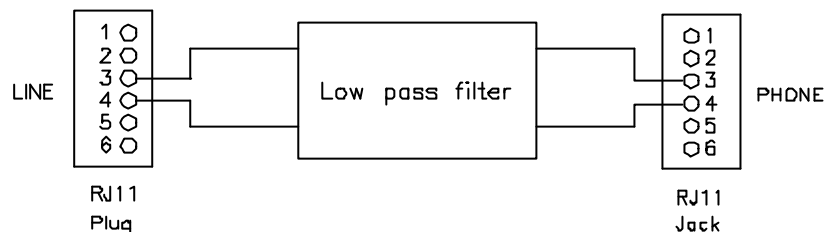
3. Abbreviations:

ADSL	Asymmetric Digital Subscriber Line
CO	Central Office
CPE	Customer Premise Equipment.
POTS	Plain Old Telephone Service
RT	Remote Terminal
DSL-NT	Network termination of ADSL

4. Technical requirements:

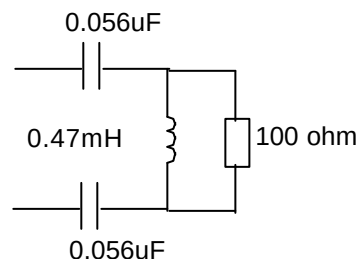
4.1. Schematic:

The following drawing illustrate the schematic of this product.



4.2. ZHP-r definition :

To facilitate testing of the inline filter independently of the actual modem or specific vendor, ZHP-r is defined to allow proper termination of the XDSL port during voice band testing. The ZHP-r is valid only for voice band frequency. The combination of capacitors in the ZHP-r is only representative. The input shall be 27nF however derived. ZHP-r equivalent circuit is shown below :



4.3. Electrical specification :

The low pass filter shall satisfy the following parametric limits with a complex impedance ZNL shown in this table across the Line side of this device . The following requirement is specified for a single splitter.

Splitter parameter	Electrical requirements	
	Range	values
Frequency range		
Splitter bandwidth		DC to 3.4KHz
Nominal voice band		200Hz to 4KHz
Billing tone		12KHz±80Hz
Ringing frequency		17Hz to 23Hz
ADSL band		25KHz to 12MHz
Line Impedance ZNL		1330ohm // (348ohm 0.1μF)
Modem impedance		100 ohm
Operation voltage voice band		
Nominal signal		21mVpp to 5.4 Vpp
Billing tone		10Vpp to 30.2Vpp
Ringing signal		40Vrms to 106Vrms(113Vpp to 424 Vpp)
DC voltage		0V to -80V ANSI 6.98
Max. AC voltage		150Vrms with -105VDC offset
Max. differential		320V
Current voice band		
Loop current		<90mA
Transient current(on/off hook)		<90mA
DC Resistance		
DC Resistance		<25 ohm
Isolation resistance tip/ring		>5 Mohm
Voice –band characteristic		
Insertion loss (one splitter) on hook	1004Hz	<1.5 ~ -0.5 dB
Insertion loss (with four added parallel filters)	1004Hz	<6.5 ~ -1.0 dB
Insertion loss (one splitter) off hook	1004Hz	<0.5 ~ -0.5 dB
Insertion loss (multiple five filters)	1004Hz	<1.0 ~ -1.0 dB

Splitter parameter	Electrical requirements	
	Range	values
Insertion loss distortion (one splitter) on hook (Relative to 1004Hz)	200Hz~1KHz	<1.5 ~ -1.5 dB
	1KHz~2.8 KHz	<1.5 ~ -1.5 dB
Insertion loss (multiple five filters)on hook (Relative to 1004Hz)	200Hz~1KHz	<2 ~ -5.5 dB
	1KHz~2.8 KHz	<2 ~ -2 dB
Insertion loss distortion (one splitter) off hook (Relative to 1004Hz)	200Hz~3.4 KHz	<0.5 ~ -1.0 dB
	3.4KHz~4.0 KHz	<1.0 ~ -1.5 dB
Insertion loss (multiple five filters)off hook (Relative to 1004Hz)	200Hz~3.4 KHz	<2.5 ~ -1.5 dB
	3.4KHz~4.0 KHz	<3.25 ~ -2.0 dB
Return loss with four added parallel filters phone side	@ERL	>9.0 dB
	@SRLL	>13.0dB
	@SRLH	>3 dB
Return loss with four added parallel filters Line side	@ERL	>10 dB
	@SRLL	>12 dB
	@SRLH	>5 dB
Longitudinal conversion loss LCL	200Hz to 3KHz	>53 dB
ADSL modem interface		
Isolation voltage		>2000Vrms for 1 minute
ADSL band characteristic		
Stop band attenuation	25KHz<f<50KHz	>21 dB
	50KHz<f<1MHz	>25 dB

4.4. DC characteristic :

All requirement of this specification can be met in the presence of all POTS loop currents from 0mA to 100mA. This in line filter can pass POTS tip-to-ring dc voltages of 0V to 105V and ringing signals of 40V to 106Vrms at any frequency from 17Hz to 23Hz with a dc component in the range from 0V to 105V. The dc resistance from tip-to-ring at the line port interface with the phone interface shorted, shall be less than or equal to 25 ohms for one splitter. The DC resistance from tip-to-ground and from ring-to-ground at the 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.

4.5. Test method :

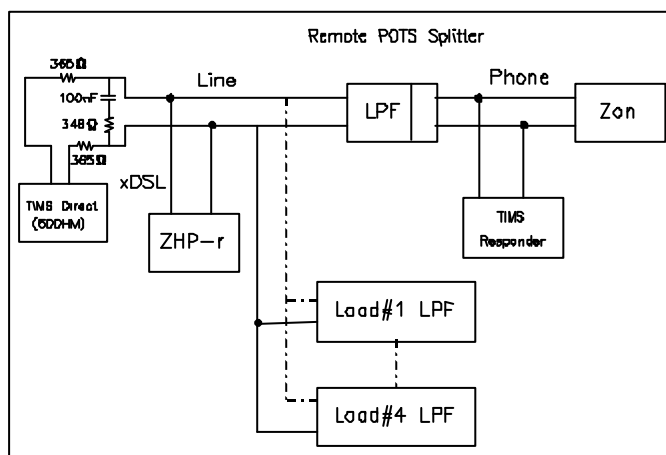
4.5.1. On hook insertion loss :

The insertion loss of a device connected into a given transmission system is defined as the ratio, expressed in dB, of the load power available(before and after insertion) delivered to the output network beyond the point of insertion at a given frequency. In general , the insertion loss is defined as the ratio, expressed in dB of the power delivered to a load with the circuit in place and the power delivered to a load without the circuit in place. The added insertion loss shall be measured using the test up in figure 3. For measuring POTS band insertion loss for single filter module also a single filter wit four added parallel load filters. General Insertion loss equation can be expressed as following. Insertion loss = $20 \log |V_2 / V_1|$ dB where

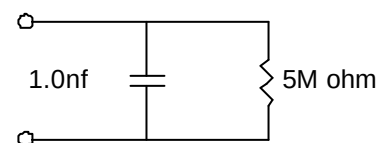
V1 = the measured voltage value of load without LPF in circuit.

V2 = the measured voltage value of load with LPF in circuit.

The test setup is shown in drawing below. :



Zon defined:



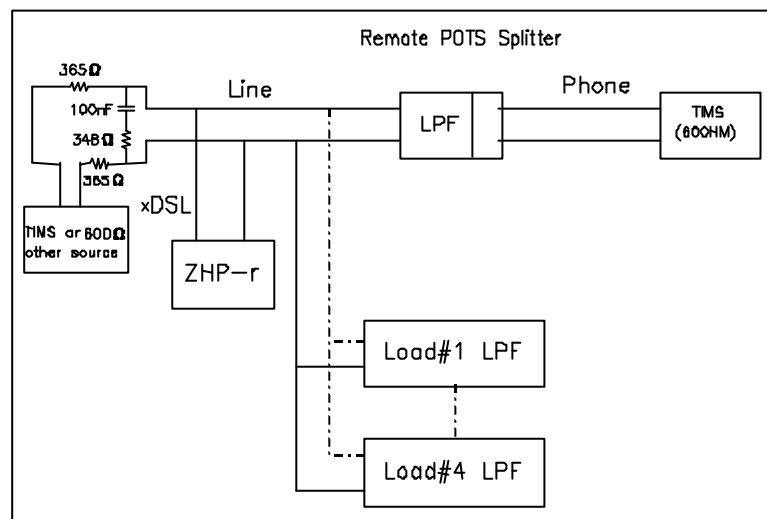
4.5.2. Off hook insertion loss :

The insertion loss of a device connected into a given transmission system is defined as the ratio, expressed in dB, of the load power available (before and after insertion) delivered to the output network beyond the point of insertion at a given frequency. In general, the insertion loss is defined as the ratio, expressed in dB of the power delivered to a load with the circuit in place and the power delivered to a load without the circuit in place. The added insertion loss shall be measured using the test up in figure 3. For measuring POTS band insertion loss for single filter module also a single filter with four added parallel load filters. General Insertion loss equation can be expressed as following. Insertion loss = $20 \log |V_2 / V_1|$ dB where

V1 = the measured voltage value of load without LPF in circuit.

V2 = the measured voltage value of load with LPF in circuit.

The test setup is shown in drawing below. :



4.5.3. Return loss :

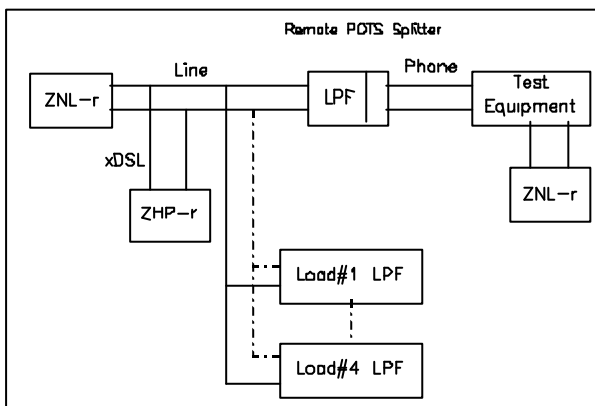
Return loss measure the amount of energy that is lost due to reflection which resulted from impedance mismatching at the interface. Return loss is essentially defined as the ratio of the power incident upon a given transmission system to the power reflected caused by impedance mismatch with respect to reference impedance at the interface between source and device. Return loss figure are a function of the impedance of the circuit involved and are therefore frequency dependent. These impedance must be closely maintained in order to reduce the possibility of undesirable reflection and echoes which in long distance circuit the telephone user or destroy the data being sent. To perform the return loss test ,open ,short, load calibration must be done prior measurement while the LCZ impedance Analyzer being selected in impedance mode. Return loss is general expressed in decibels. General Return loss equation as below:
Return loss = $20 \log \left| \frac{Z_L + Z_M}{Z_L - Z_M} \right| \text{ dB}$

Where Z_L = the reference impedance

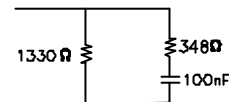
Z_M = the measured impedance

The test setup is shown in drawing below:

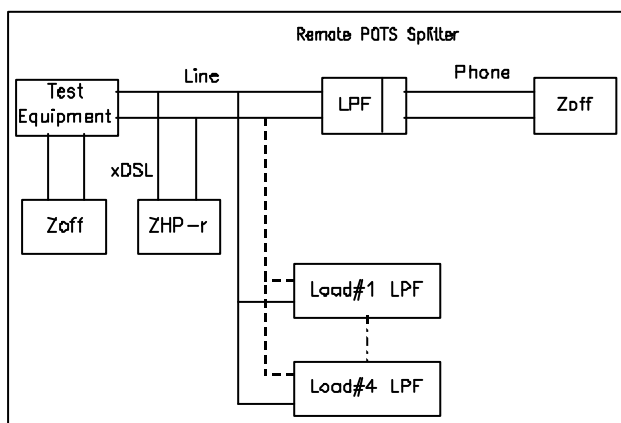
4.5.3.1. Phone port return loss :



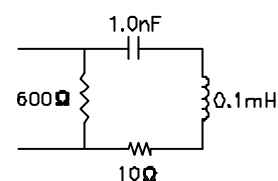
ZNL-r defined



4.5.3.2. Line port return loss :



Zoff defined



5. Environmental condition:

5.1. EMC , surge and power- contact:

The splitter has to comply with EMC Requirements as per ITU K21, so the following requirements must be taken into consideration:

No	Test	Test specification	Number of tests
1	Lightning surge simulation	1500V , 10/700µs , 200ms	10
2	Power induction	600V , 1s	5
3	Power contact	230V , 15 minute	1

5.2. Climatic condition:

5.2.1. Operating temperature:

Application	indoor
Low ambient temperature	-5°C
High ambient temperature	+45°C
(according to ETS 300 019, class 3.2)	

5.2.2. Storage and transport:

Low ambient temperature	-40°C
High ambient temperature	+85°C
(according to ETS 300 019, transport: class 2.3, storage: class 1.2)	

6. Reliability condition:

6.1. Operation:

Test	Test specification
Vibration sinusoidal	IEC 68 Part 2-6 10 to 58Hz 0,075mm 58 to 500Hz 10m/S ² , 1octaver/minute 3 axis; every 10 cycles
Shock(half sine)	IEC 68 Part 2-27 ≤100kg 100m/ S ² 11ms 6 directions; every 3 shocks

6.2. Handling:

Test	Test specification
Freefall	IEC 68 Part 2-32 Stand alone:<10kg 75mm Built in:2x ground area

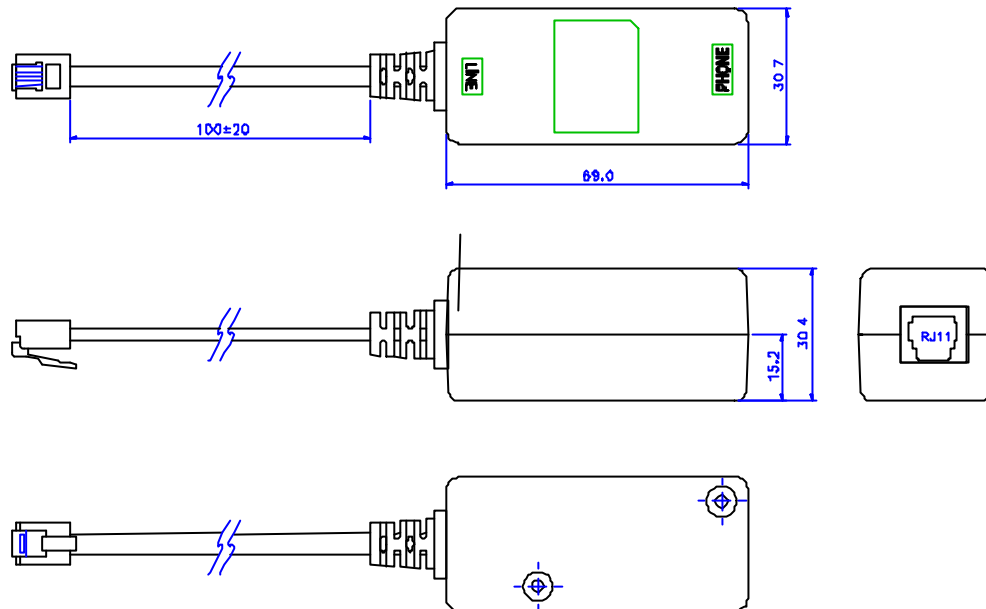
6.3. Storage and transport:

Test	Test specification
Vibration(random)	IEC 68 Part 2-64
Bump	IEC 68 Part 2-29
Freefall	IEC 68 Part 2-32 <10kg 800mm Twice at any possible Transport position on concrete floor

6.4 . Product safety :

Test	Test specification
Electrical hazard	EN 60950 (A4), (≡VDE 0805)
Mechanical hazard	EN 60950 (A4), (≡VDE 0805)
Fire hazard	EN 60950 (A4), (≡VDE 0805)

7. Mechanical condition:



Note :

- 1: Connect the line side of the microfilter to the wall jack and the phone side of the microfilter to the phone.
- 2: Incorrect connection will significantly affect the performance and operation.
- 3 : Unless otherwise specified , all tolerance are mm(inch)±0.25(0.010)