

APPLIANCE MINI INTERFACE TECHNICAL GUIDE

VERSION 1.0

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1. INTRODUCTION

This document is the technical guide both to the **Appliance Mini Interface** (AMI) interface module and to the most common **Appliance Cables**. The AMI is a USB interface module that has been designed by Cross Technology and Innovation (CTI) department in order to suit laboratory and field service applications. The need to have a USB interface module is due to the fact that in the current personal computers the serial port has been replaced by the USB port.



Fig. 1. AMI Unit (6-Way Plug Variant)



Fig. 2. AMI Unit (8-Way Plug Variant)

1.1. MAIN FEATURES

The main features of the AMI are the following:

- Support of DAAS (Domestic Appliance Acquisition System) and MACS (Major Appliance Communication System) standard communication protocols from Electrolux. DAAS is a point-to-point protocol that allows the communication between an electronic appliance and an external unit. MACS is a peer-to-peer bus protocol that allows the communication among different units both inside and outside an electronic appliance.
- Full backward compatibility with the previous DAAS modules from Electrolux.
- External power supply (maximum absolute range): from 7.5V_{DC} to 12V_{DC} unregulated. The recommended power supply value is 9V_{DC} unregulated.

AMI module automatically uses the external power supply when you connect the corresponding connector.

- Output Current: the AMI is able to provide to the target board a regulated 5V_{DC} power supply. This is order to allow the configuration of a board without the need to connect it to the mains power supply. The typical value of the maximum current that you can draw from the interface module depends on whether you use an external power supply or not. If you use an external power supply, the AMI is able to provide up to 150mA (with less than 5% in output voltage drop). If you use instead only the power supply from the USB cable, the AMI is able to provide up to 80mA (with less than 5% in output voltage drop).
- USB power capability: if the module is attached to the host PC via the USB cable, in most cases it is not necessary to provide an external power. You must use an external power supply when the target board absorbs more than 80mA. This may be the case when you use the AMI to program a board with several LEDs and/or an LCD display that is not connected to the mains supply (230 V_{AC}).
- The AMI module is designed to ensure 3750 V_{DC} isolation between the primary and the secondary stage. The primary stage is the AMI portion that is electrically in contact with the host personal computer. The secondary stage is instead the AMI portion that is electrically in contact with the target electronic board.
- AMI units for field service applications are 100% tested for electrical insulation up to 2500 V_{DC}.
- The Power LED is green when the module is powered on. If you use an external power supply, you can notice that the green color of the LED is brighter.
- The Secondary Power LED is yellow when +5V_{DC} is present on the secondary stage. +5V_{DC} power supply is present in the secondary stage both when you enable it with the secondary power switch and when the AMI is connected to an appliance connected to the mains voltage.
- You connect the AMI to the PC using a USB 2.0 male A to male B cable. The maximum length of the cable is 5 meters. However the recommended length is 1.8 meters or less. The longest the USB cable, the highest is the chance of communication errors. This is true especially when you are using the MACS communication protocol.

- Maximum Output Power that the AMI can provide to the target board: typical 0.74W (@9V power supply, 150 mA output current)
- Maximum Input Power that the AMI absorbs from the external power supply: typical 2.6W (@9V power supply, 150 mA output current)
- Main Unit Dimensions (width-height-depth): 49.9 x 24.1 x 89.4 mm
- Main Unit Weight: about 200g

1.2. ACRONYMS, ABBREVIATIONS, AND REFERENCES

AC	Alternating Current
ACK	Appliance Connection Kit
AMI	Appliance Mini Interface
CTI	Cross Technology and Innovation
DAAS	Domestic Appliance Acquisition System
DC	Direct Current
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MACS	Major Appliance Communication System
PC	Personal Computer
SSE	Service Support Europe
USB	Universal Serial Bus

2. MAIN UNIT ITEMS

The following figures show the main mechanical elements that make up the AMI:

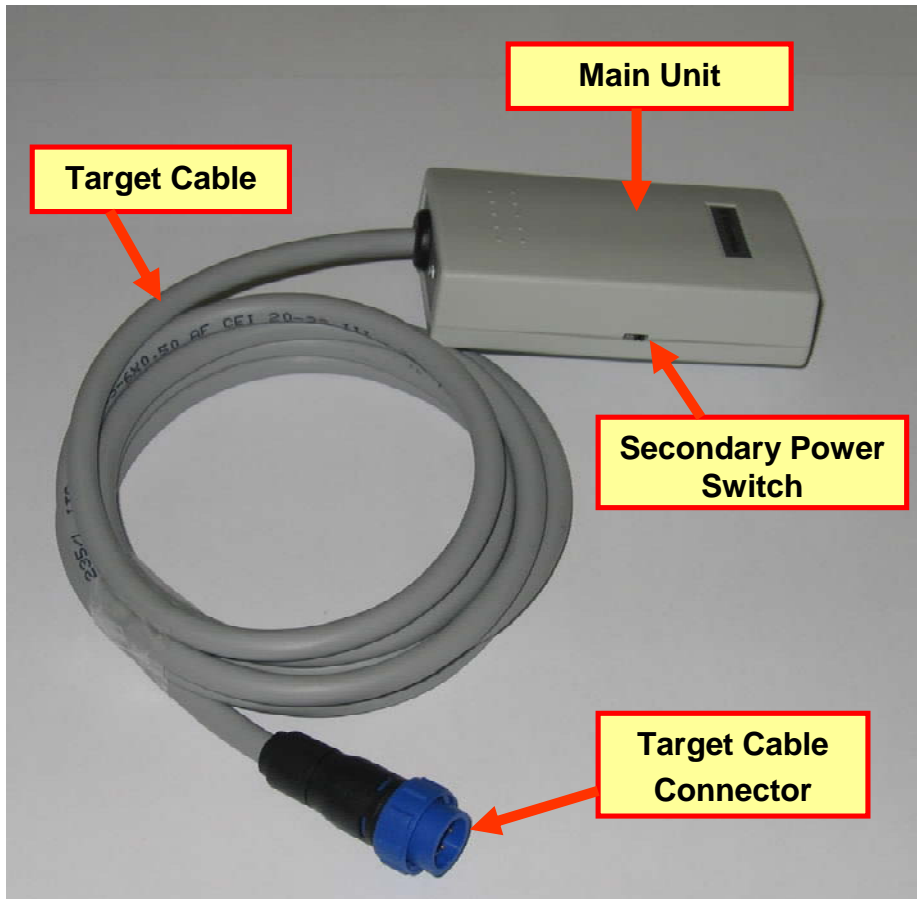
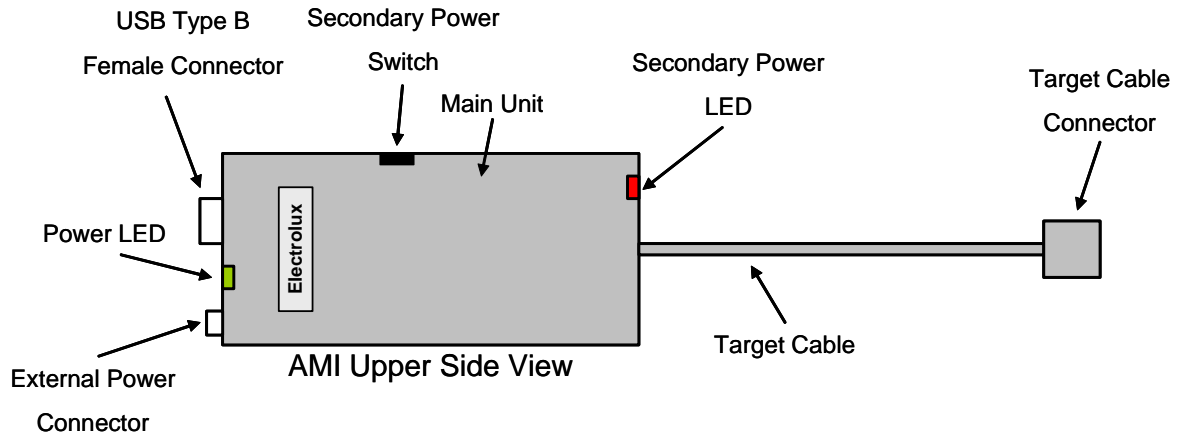


Fig. 3. AMI Items

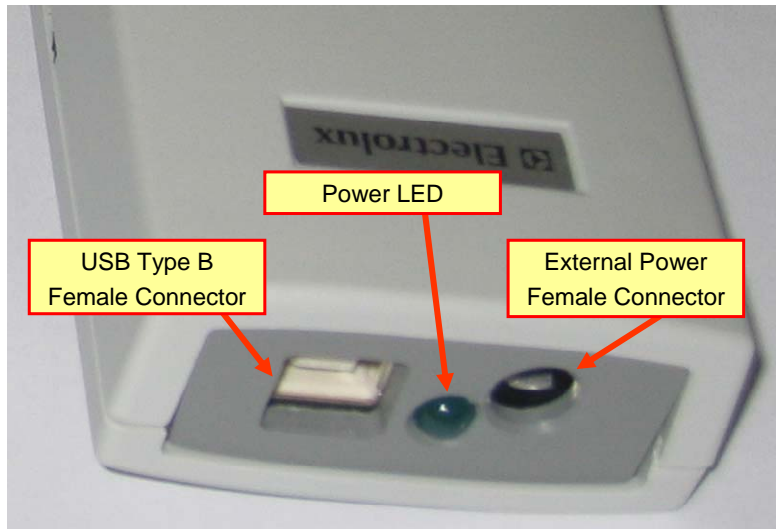
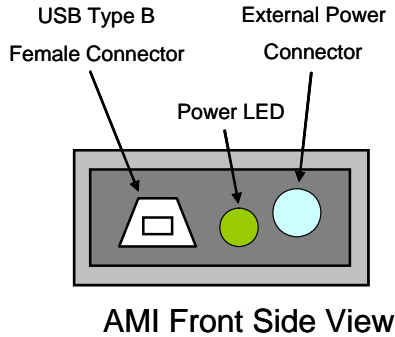


Fig. 4. AMI Front View from the Primary Stage

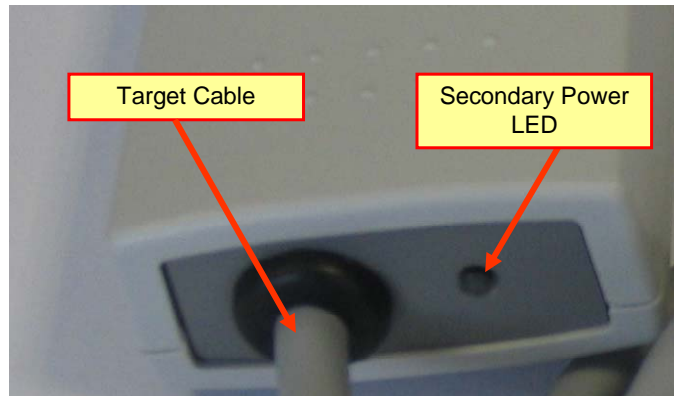
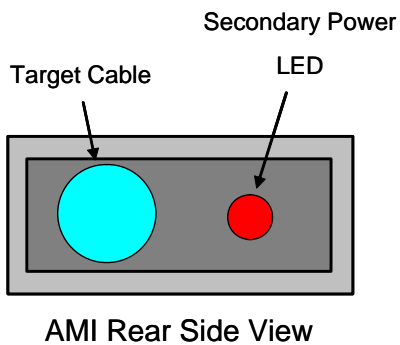


Fig. 5. AMI Rear View from the Secondary Stage

A small plastic box is the **Main Unit** of the AMI.

The Main Unit houses a standard USB type B Female Connector (Fig. 6) for the USB interface on the PC side. Table 2.1 lists the pin assignments of the USB connector:

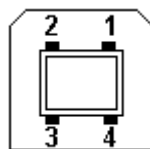


Fig. 6. USB Type B Female Connector

Pin	Name	Notes
1	VBUS	Power
2	D-	Data -
3	D+	Data +
4	GND	Ground

Table 2.1 USB Type B Female Connector Pin Assignment

You connect the AMI to the PC using a standard USB cable Male A to Male B. The maximum length of the USB cable is 5 meters.



Fig. 7. Standard USB Cable Male A to Male B

The **External Power Connector** is a standard male jack connector (2.5 mm diameter):

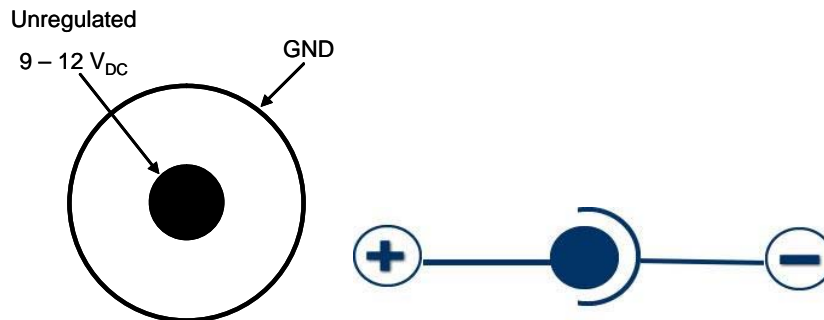


Fig. 8. Power Connector

The **Power LED** has only one colour: green when the module is powered on.

The **External Power LED** has only one color: yellow when the $+5V_{DC}$ are present on the secondary stage. To provide $+5V_{DC}$ to the secondary stage it is necessary to activate the **Secondary Power Switch**.

The **Target Cable** is a shielded cable that connects the AMI to the Appliance Cable.

2.1. Target Cable Connector

Depending on the actual AMI variant, the **Target Cable Connector** can be either a 6-Way Plug or an 8-Way Plug.

The older AMI variant features a 6-Way Plug and it mounts a **Tyco 172339-1** plug housing:



Fig. 9. Tyco 172339-1 6-Way Plug Housing

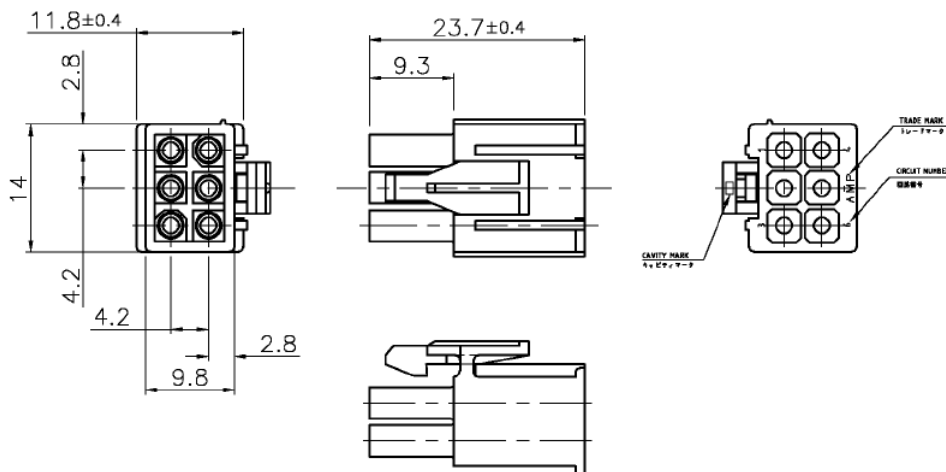
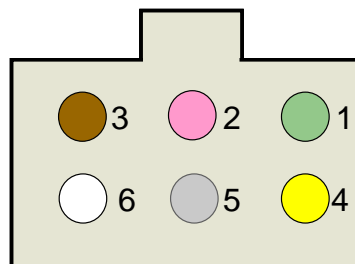


Fig. 10. Tyco 172339-1 6-Way Plug Housing Dimensions

6-Way Plug – Male Contacts (Tyco 172339-1 plug housing) (Front View – Contacts Side)



- 1 Target Device RxD (TxD Host)
- 2: Target Device TxD (RxD Host)
- 3: MACS Cable Select
- 4: GND
- 5: MACS Signal (single-ended)
- 6: +5VDC (regulated)

Fig. 11. Tyco 172339-1 6-Way Plug Pin Assignments

The latest AMI version, specifically designed for field service, features an 8-Way Plug with golden contact and it mounts a **Bulgin Buccaneer PX041008P** plug housing:



Fig. 12. Bulgin Buccaneer PX041008P Plug Housing

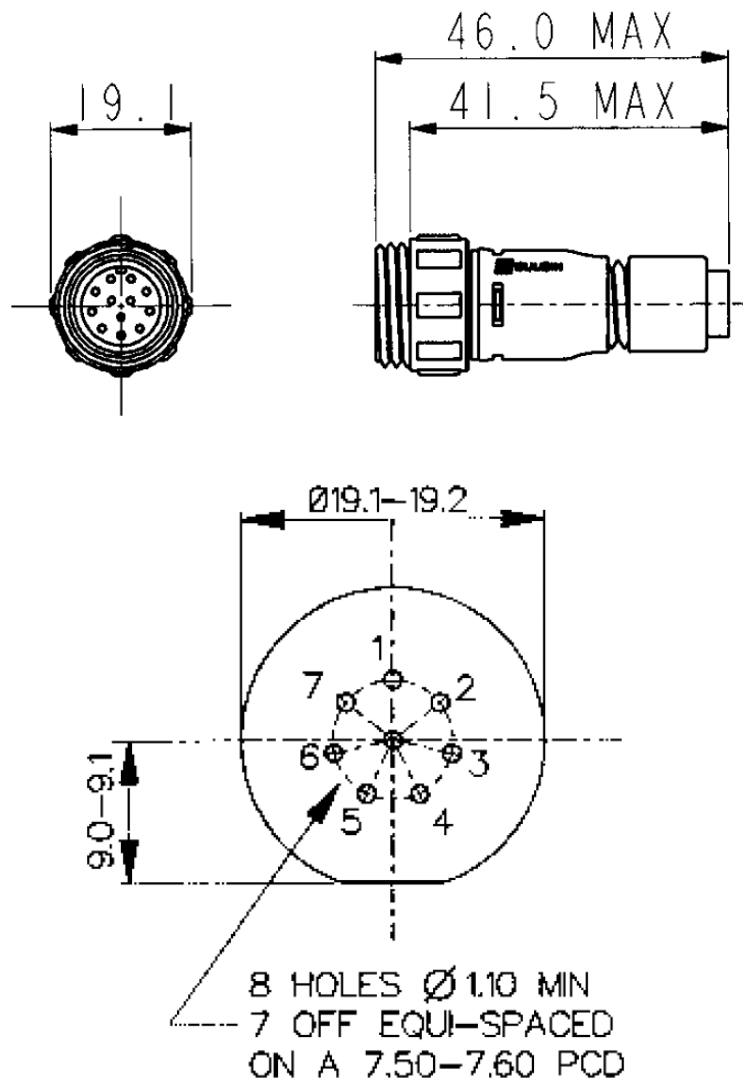
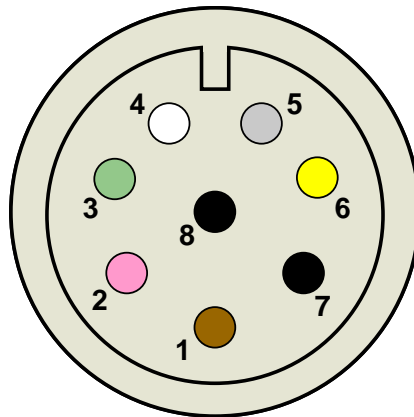


Fig. 13. Bulgin Buccaneer PX041008P Plug Housing Dimensions (mm) viewed from rear panel

The 8-Way Plug has the following pin assignments:

8-Holes Plug – Male Contacts
(Bulgin Buccaneer code PX041008P)
(Front View – Contacts Side)



- 1: MACS Cable Select
- 2: Target Device TxD (RxD Host)
- 3: Target Device RxD (TxD Host)
- 4: +5VDC (regulated)
- 5: MACS Signal (single-ended)
- 6: GND
- 7: not used
- 8: not used

Note: the colors of the pins are referred to the internal wires of AMI

Fig. 14. Bulgin Buccaneer PX041008P Plug Pin Assignment

3. ORDERING INFORMATION

For ordering a complete Appliance Connection Kit (ACK), or single AMI modules and accessories, you should turn to the following Electrolux departments:

- For Field Service applications:
Service Support Europe (SSE)
Muggenhofer Straße, 135
D90429 - Nürnberg - Germany
Attn. Mr. Wilhelm Nießen
Phone: +49-911-3231876
Mail: wilhelm.niessen@electrolux.de
- For Laboratory use:
Cross Technology and Innovation (CTI)
Corso Lino Zanussi, 30
33080 Porcia (PN) - Italy
Attn. Mr. Giovanni Dal Bello
Phone: +39-0434-394977
Mail: giovanni.dal-bello@electrolux.it

4. APPLIANCE CABLES

You need an **Appliance Cable** to complete the connection to the target board. The appliance cable connects the Target Cable Connector to the electronic board:

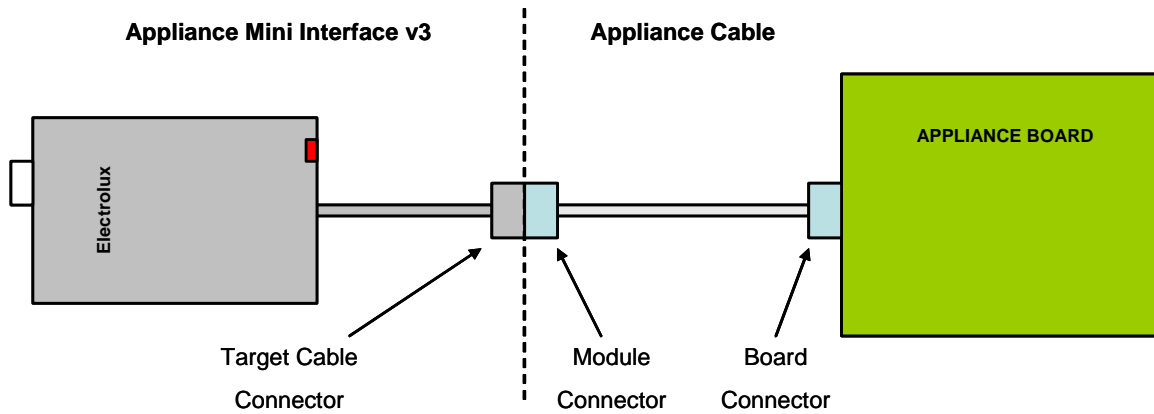


Fig. 15. AMI, Appliance Cable, and Board

The ends of the Appliance Cable are the Module Connector and the Board Connector.

The Module Connector matches the Target Cable Connector, while the Board Connector plugs into the Appliance Board.

4.1. Module Connector Pin Assignments

The following figure provides the pin assignments for the standard 6-Way plug AMI variant (Tyco cap housing):

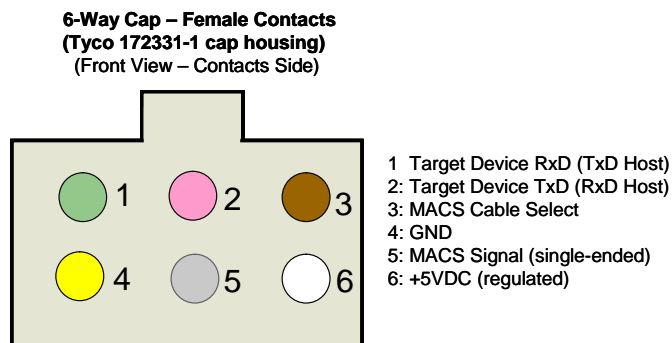


Fig. 16. Tyco 172331-1 Module Connector Pin Assignment

The following figure shows the pin assignments for the 8-Way plug AMI variant (Buccaneer cap housing):

**8-Holes Socket – Female Contacts
(Bulgin Buccaneer code PX041108S)
(Front View – Contacts Insertion Side)**

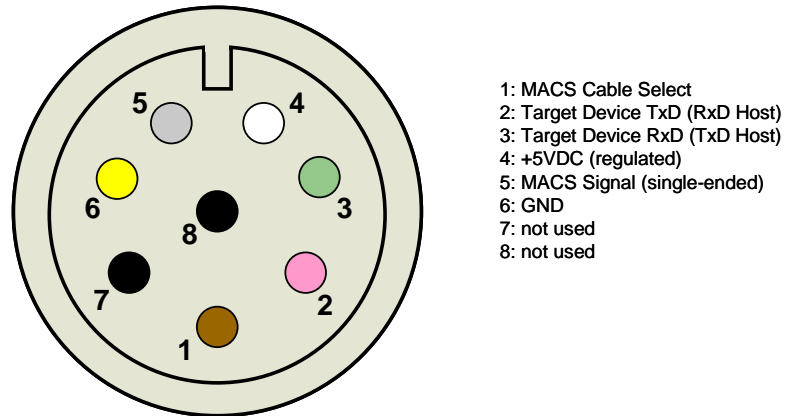


Fig. 17. Bulgin Buccaneer PX041008S Socket Pin Assignment

The actual pins that are used depend on the communication protocol:

- appliance cables for the DAAS protocol do not use the pins to handle the MACS communication (pin #1 and pin #5);
- appliance cables for the MACS do not use the pins to handle the DAAS communication (pin #2 and pin #3).

4.2. Board Connector Pin Assignments

The following figure shows the pin assignments for the DAAS cables with RAST2.5 edge connector:

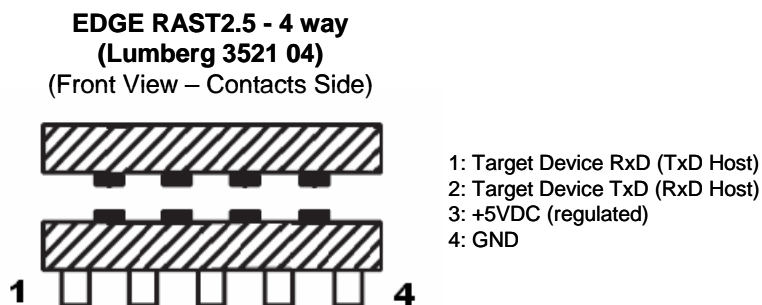


Fig. 18. RAST2.5 Edge Connector Pin Assignments

Fig. 19 shows the pin assignments for the DAAS cables with RAST5 edge connector:

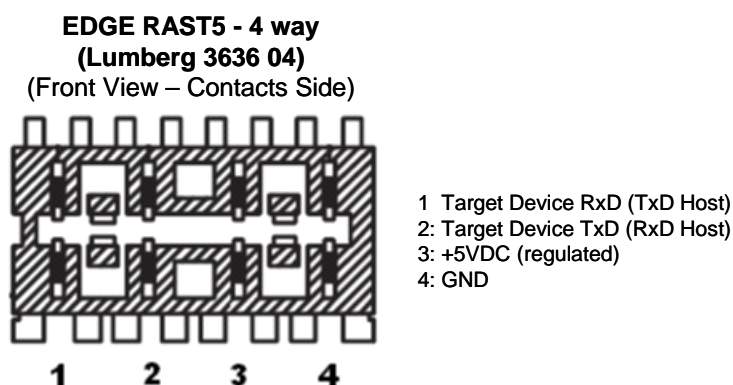


Fig. 19. RAST5 Edge Connector Pin Assignments

The following figure shows instead the pin assignments for the DAAS cables with JST NVR-04 crimp style connector (for ENV06 fabric care appliances):

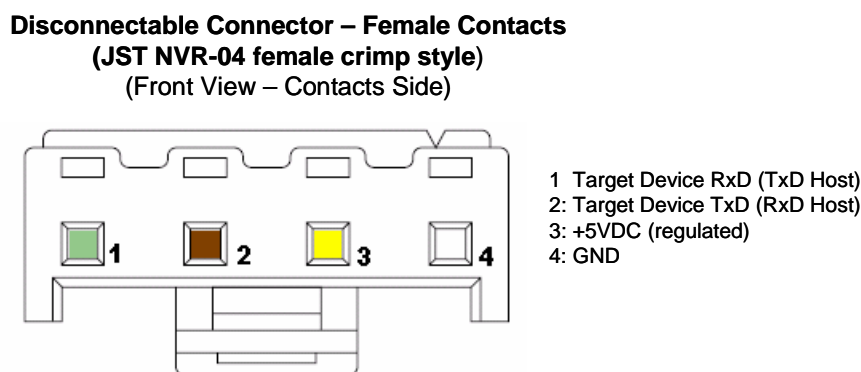


Fig. 20. JST NVR-04 Connector Pin Assignments

4.3. Appliance Cable Wirings

The current section provides the wiring diagrams of the appliance cables that you can use with the AMI.

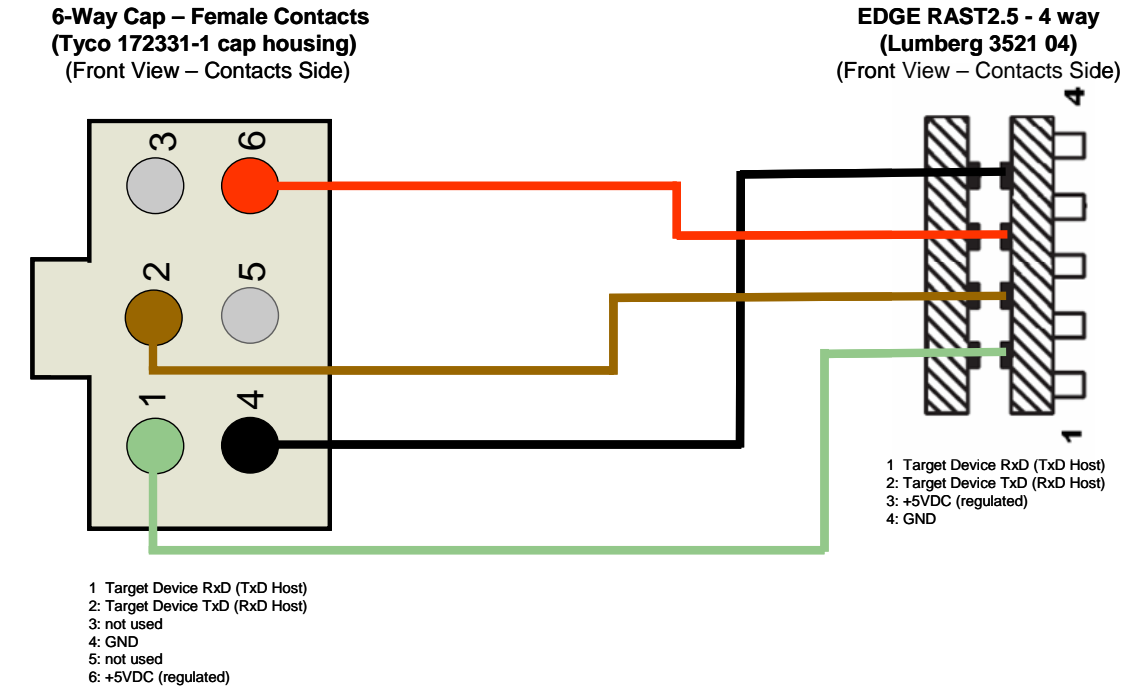


Fig. 21. RAST2.5 DAAS Cable – 6-Way Plug

**6-Way Cap – Female Contacts
(Tyco 172331-1 cap housing)
(Front View – Contacts Side)**

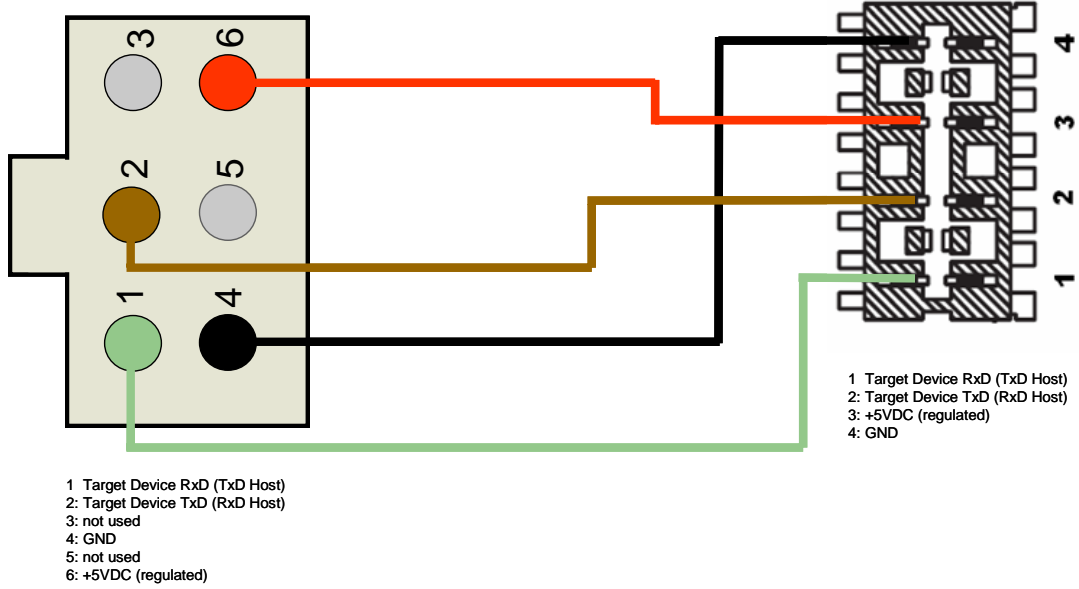


Fig. 22. RAST5 DAAS Cable – 6-Way Plug

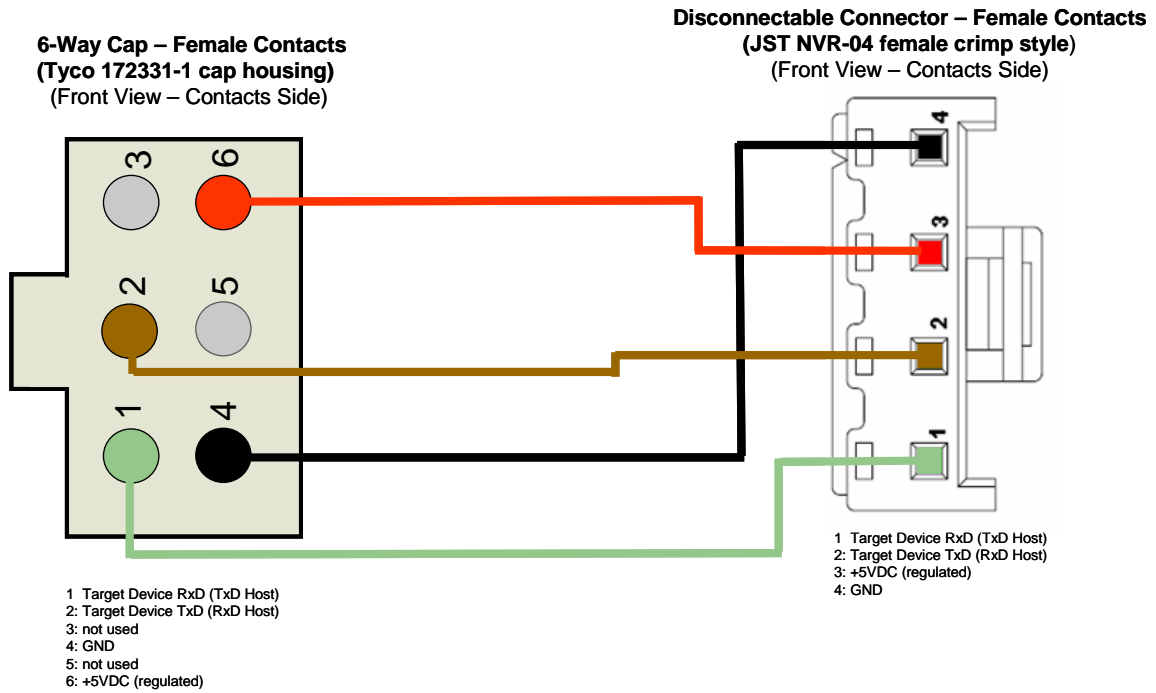


Fig. 23. JST DAAS Cable – 6-Way Plug

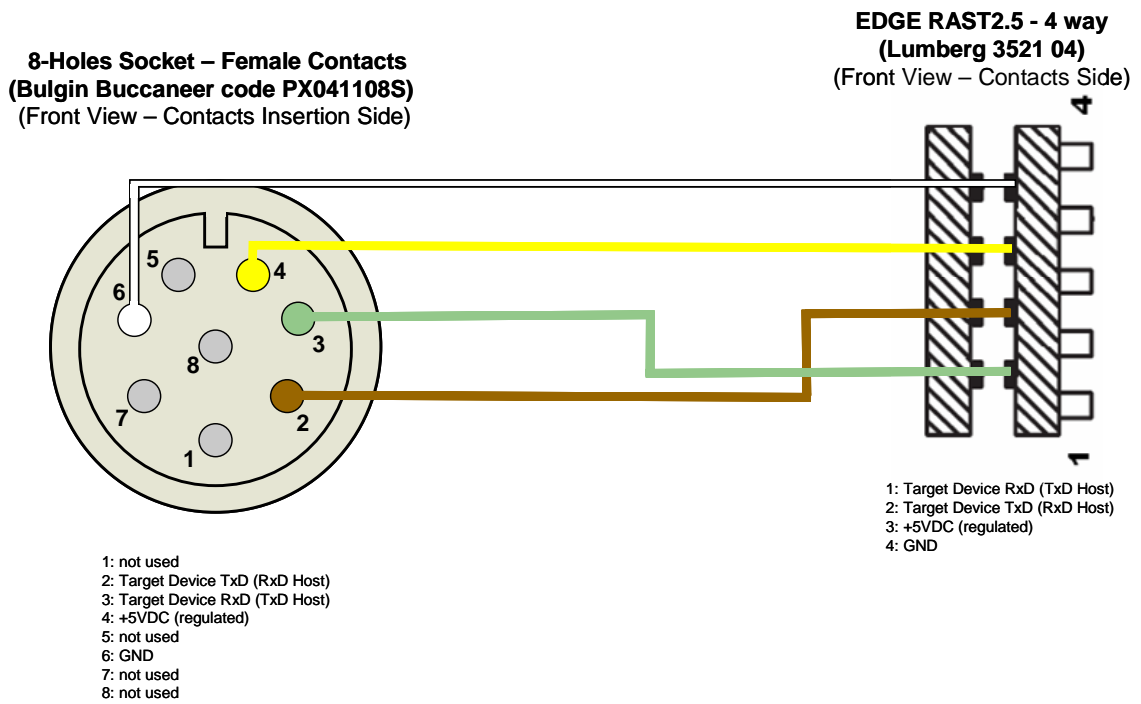


Fig. 24. RAST2.5 DAAS Cable – 8-Way Plug

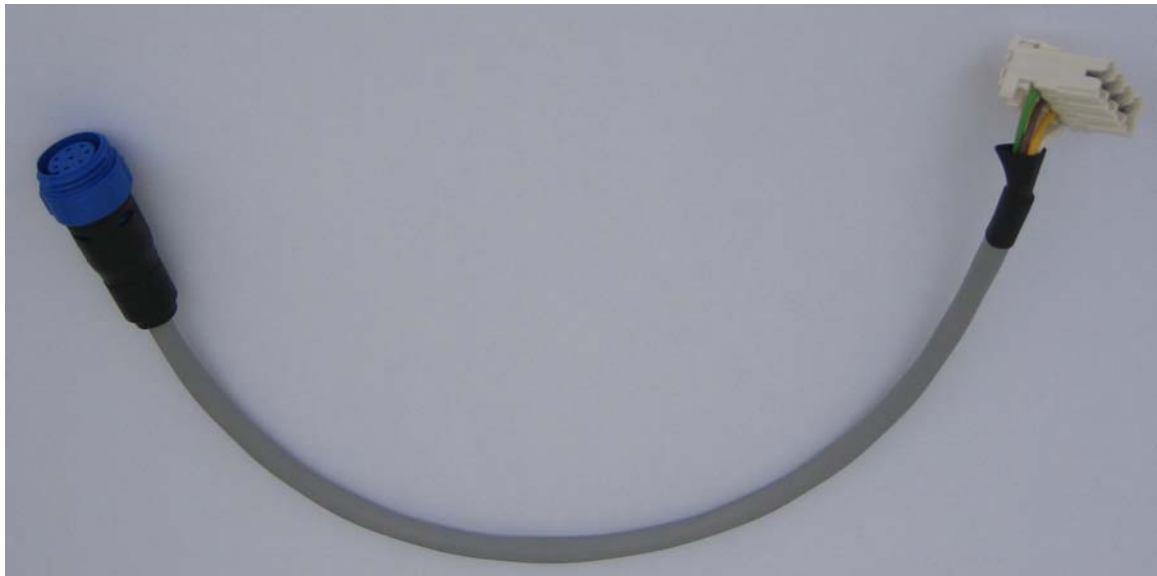
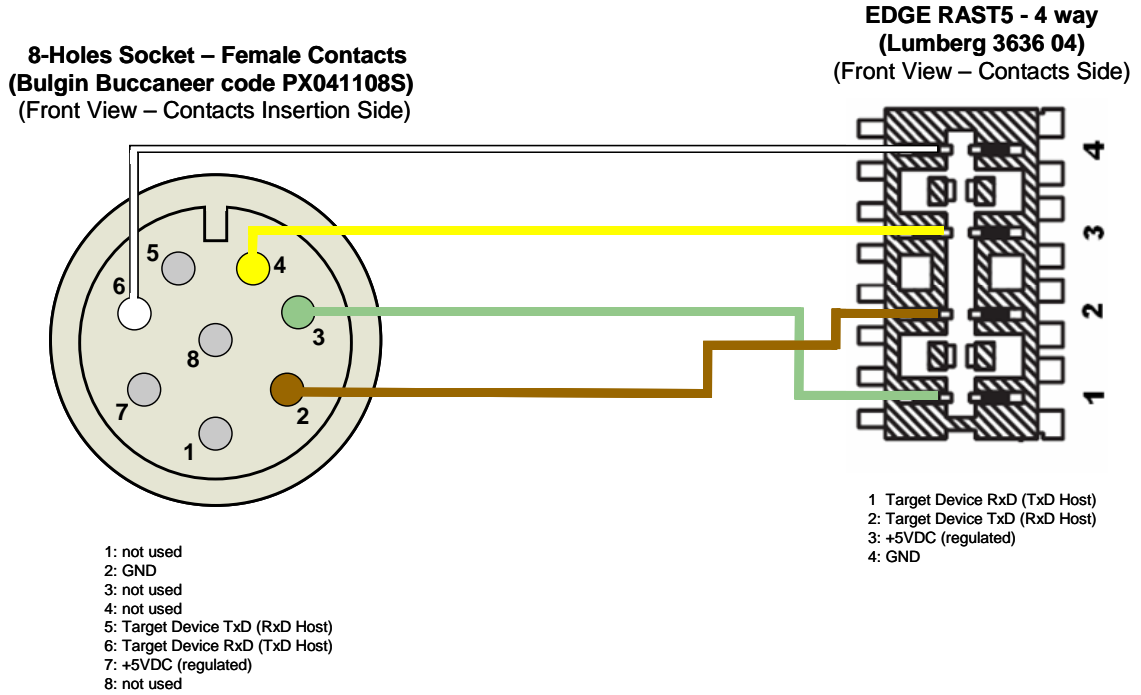


Fig. 25. RAST5 DAAS Cable – 8-Way Plug

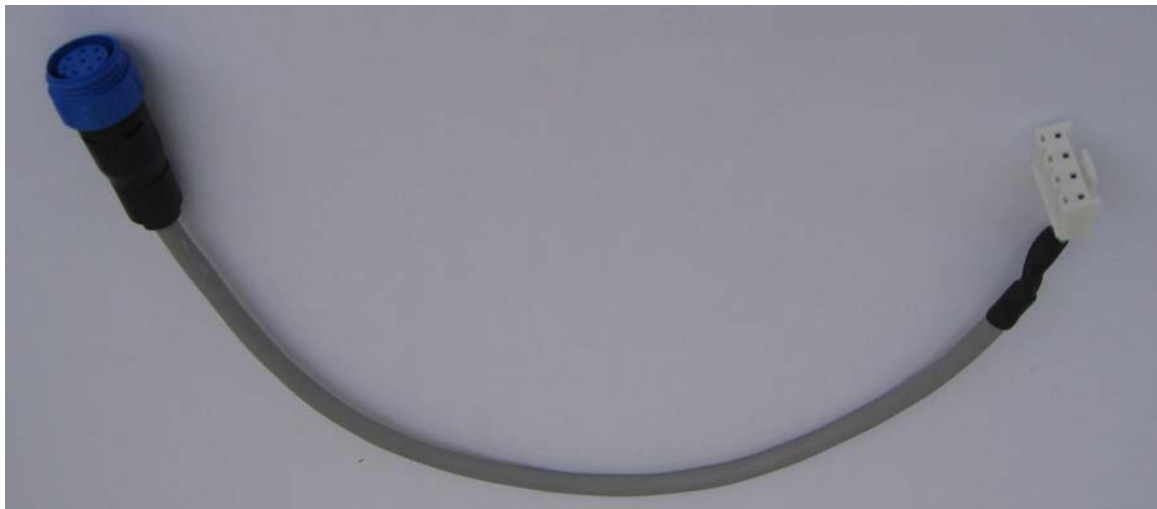
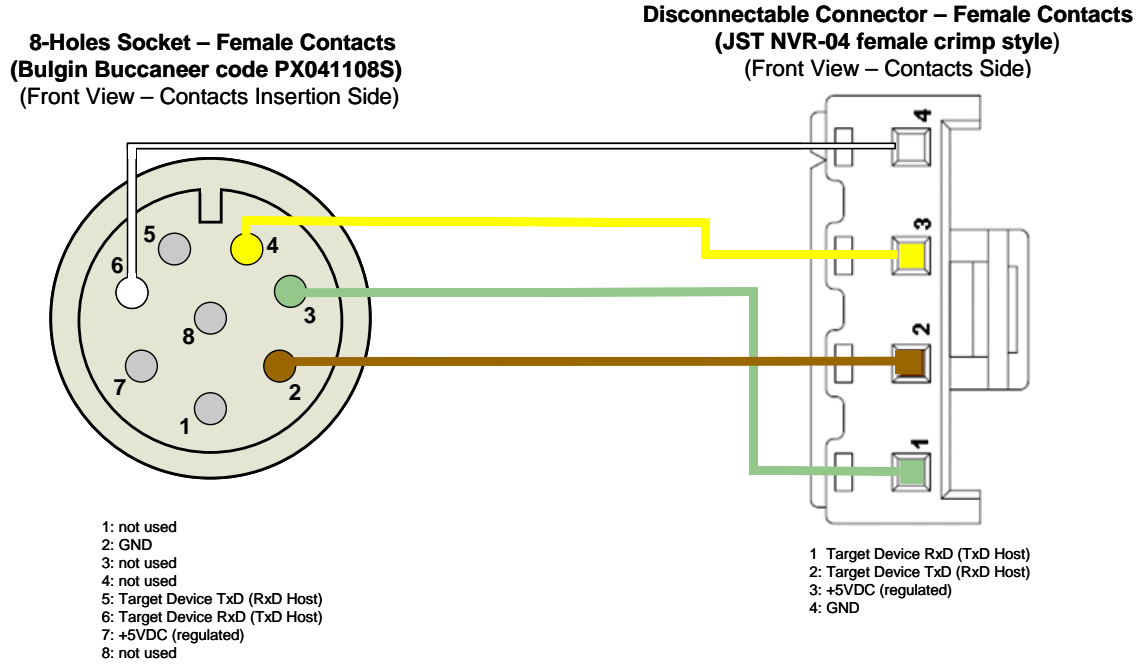


Fig. 26. JST DAAS Cable – 8-Way Plug

5. USB DRIVERS INSTALLATION

5.1. Introduction

This paragraph provides hands-on instructions on how to properly install the Universal Serial Bus (USB) drivers for the AMI interface module.

You can use the USB interface on standard PCs equipped by one of the latest Microsoft Windows operating systems with plug-and-play capabilities and with support for the Universal Serial Bus: Windows 2000, Windows XP, Windows Vista, Windows Server 2003, etc. These drivers work only in the 32-bit version of the operating system.

Please note that you cannot install the AMI drivers in Windows 98/Me.

In addition, please remember that you must log on as full Administrator in order to install the USB drivers.

5.2. Driver Signing Issues

Currently the USB drivers for the AMI are not digitally signed. In order to allow the installation of the drivers, CTI recommends setting the Driver Signing Options either to Ignore or to Warn both in Windows 2000, XP and Vista.

In order to open the Driver Signing Options dialog box, right click on My Computer, then select Properties >> Hardware >> Driver Signing:

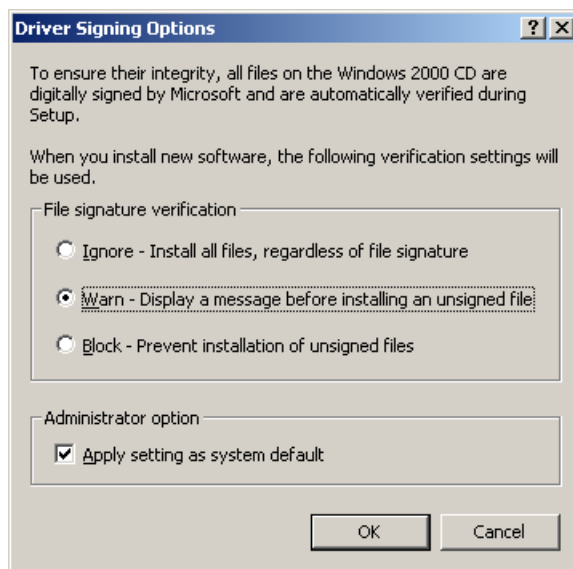


Fig. 27. Driver Signing Options

If you set the option to Warn (see Fig. 27 for reference), CTI-Software Development Group verified that only XP actually issues a warning to the user whenever he/she starts the installation of the drivers. Under XP the following dialog box appears twice during the setup:



Fig. 28. Driver Signing Warning in XP

In this case you should just select Continue Anyway and ignore the above message.

Under Vista instead, you see a dialog box that displays the following message: “Windows can’t verify the publisher of this driver software”. In this case you can safely issue the “Install this driver software anyway” command.

Currently CTI-Software Development Group does not yet know whether in the future it will certify or not the USB drivers for the appliance adapters.

5.3. Installing the drivers

The instructions that follow in this paragraph refer to Windows XP Professional Service Pack 2 – English Version. Other versions of this operating system may require slightly different commands. Although Windows 2000 and Vista require different steps, the general concepts still apply. For this reason you can refer to this section also if you are using Windows 2000 and Vista.

If you use the AMI for the first time, you need the files of the ELECTROLUX CDM Driver Disk. To install them you should follow the next simple steps (if you experience a problem please refer to the next paragraph on “driver signing” issues):

- Connect the AMI to the PC by means on a type A-B (male/male) USB cable.
- Wait for the plug-and-play (PnP) manager to detect the new hardware. You should see the following message:



Fig. 29. Found New Hardware – Step1

- When the initial dialog of the Found New Hardware Wizard appears, select “No, not this time” and press Next.



Fig. 30. Found New Hardware – Step2

- Select “Install from a list or specific location (Advanced)” and press Next.

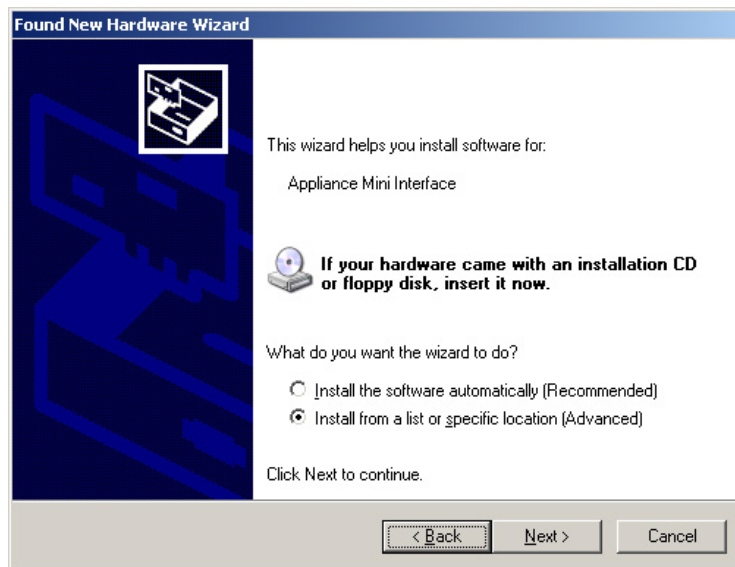


Fig. 31. Install From a Specific Location (Advanced)

- Let the wizard know where to find the drivers. If the driver files in the ELECTROLUX CDM Driver Disk stay in a floppy or a CD-ROM drives, just check “Search removable media (floppy, CD-ROM...)”. Otherwise browse to the folder that contains the driver files.

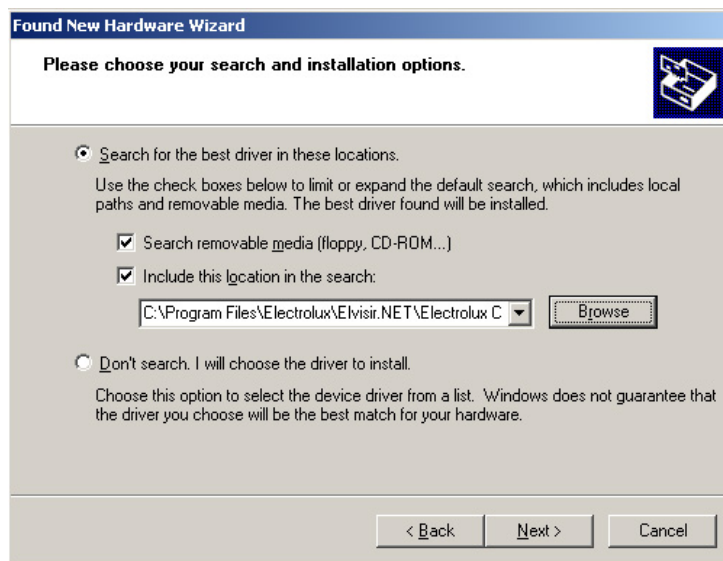


Fig. 32. Locate Driver Files

- The system locates a proper driver for the AMI interface module and it displays the following messages:

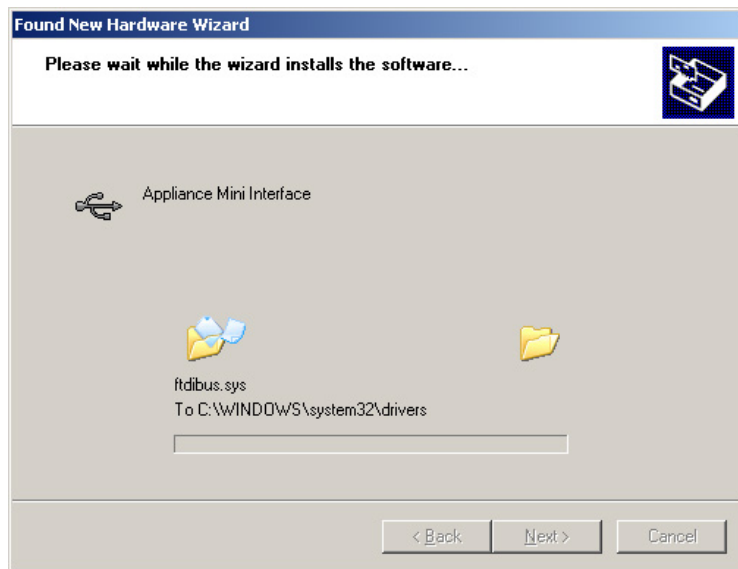


Fig. 33. Appliance Mini Interface Adapter Driver Files Search Results

- After a while, the system shows another dialog. Just press Finish to complete the installation of the USB drivers.

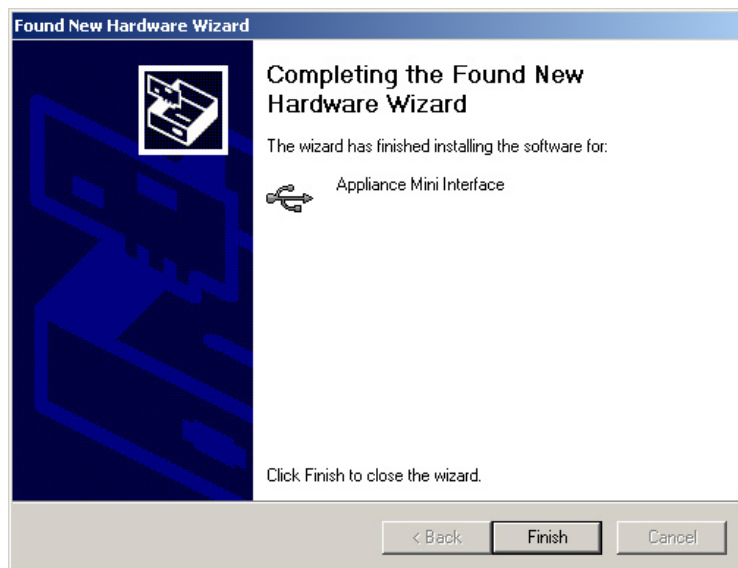


Fig. 34. Setup End

- The system now detects an additional piece of hardware (USB Serial Port). When the initial dialog of the Found New Hardware Wizard appears, select “No, not this time” and press Next.
- Select “Install from a list or specific location (Advanced)” and press Next.
- Select “Search for a suitable driver for my device (recommended)” and press Next.

- Let the wizard know where to find the drivers. If the driver files in the ELECTROLUX CDM Driver Disk stay in a floppy or a CD-ROM drives, just check “Search removable media (floppy, CD-ROM...)”. Otherwise browse to the folder that contains the driver files.
- The system locates a proper driver for the USB Serial Port and it displays the following messages:

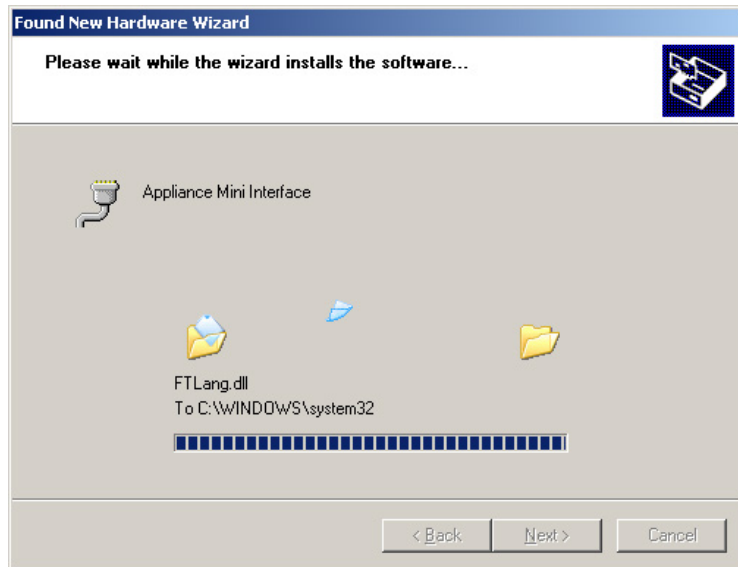


Fig. 35. USB Serial Port Driver Files Search Results

- After a while, the system shows another dialog. Just press Finish to complete the installation of the virtual COM port driver.



Fig. 36. Setup End

5.4. Verifying the setup

In order to verify the installation of the USB drivers and the correct operation of the plug-and-play features, right click on My Computer, then select Properties >> Hardware >> Device Manager.

When the interface module is connected to the PC through the USB cable, the Device Manager should display two entries showing the name of the interface module: one under “Ports (COM & LPT)” and the other under “Universal Serial Bus controllers”. For example if the “Appliance Universal Adapter” is connected:

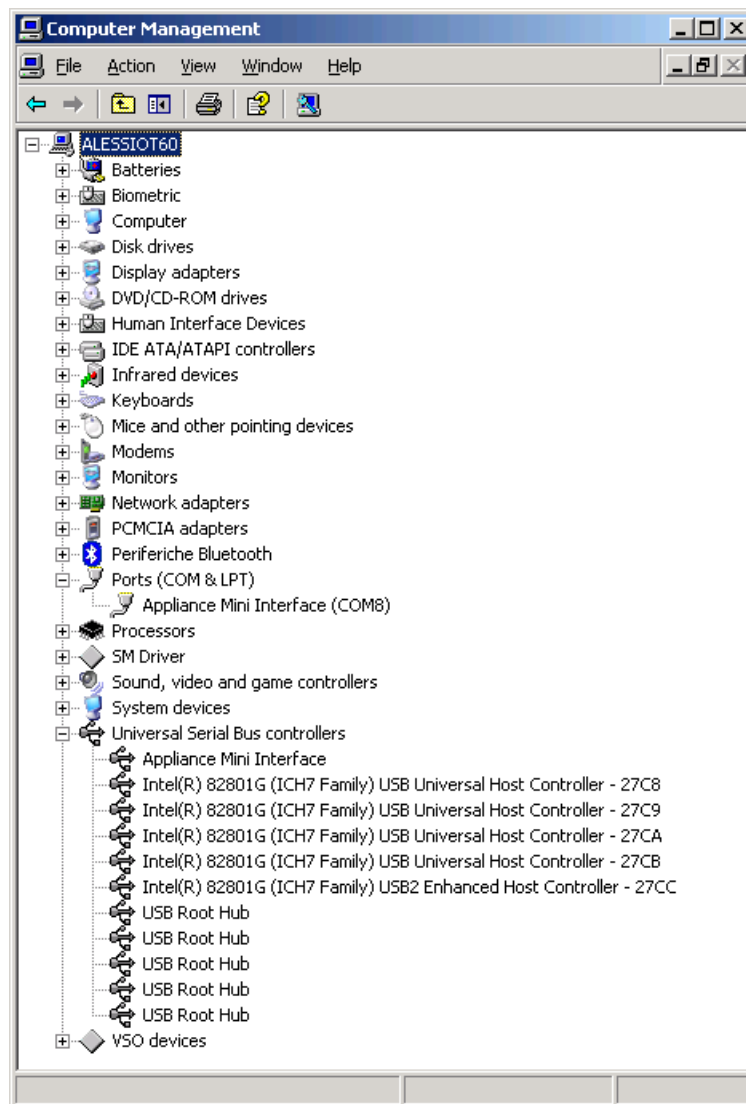


Fig. 37. Device Manager

Then verify that these entries disappear if you disconnect the interface module. Finally check that these entries appear if you turn on or connect again the module.

5.5. Changing the COM port number

If you want, after the initial setup, you can override the COM port number of a USB serial port that the installer automatically assigns.

Open the Device Manager by right clicking on My Computer, then select Properties >> Hardware >> Device Manager.

From Device Manager, expand the Ports (COM & LPT) node and select the name of the interface module (Appliance Universal Adapter). Right-click on the entry and click Properties. Select the Port Settings tab, then click Advanced. Choose the required COM port number from the list and click OK.

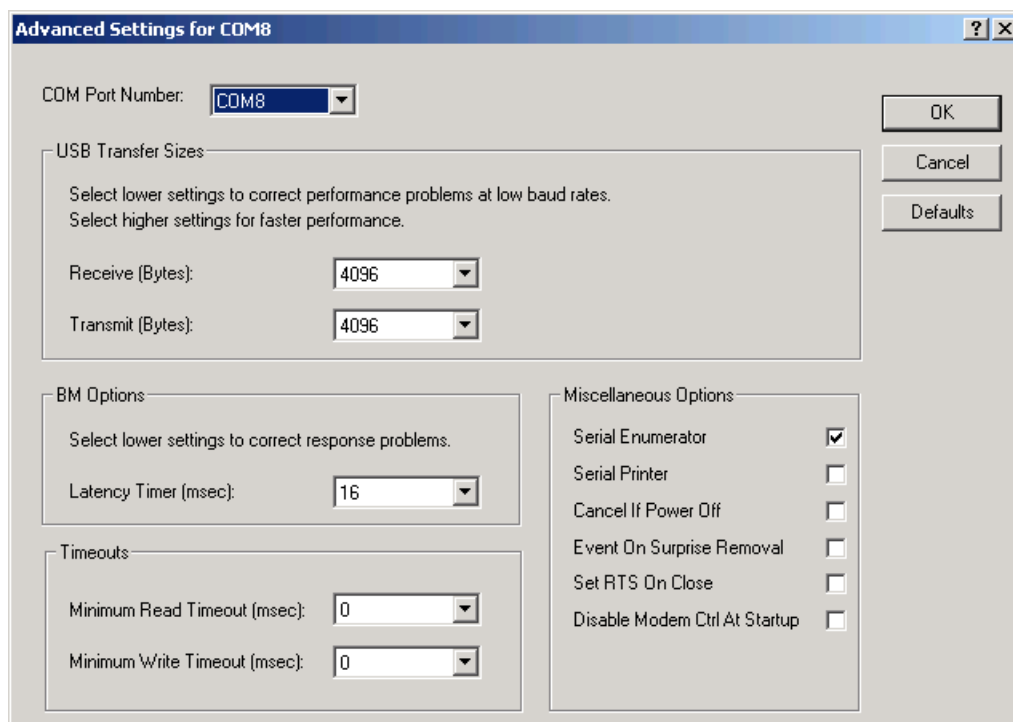


Fig. 38. COM Port Number Selection

You are recommended not to change any other options in this dialog.

5.6. Additional Options

The driver provides additional options that you may want to override.

Open the Device Manager by right click on My Computer, then select Properties >> Hardware >> Device Manager.

From Device Manager, expand the “Universal Serial Bus controllers” node and select the name of the interface module (for example Appliance Mini Interface). Right click on the entry and click Properties. Select the Advanced tab:

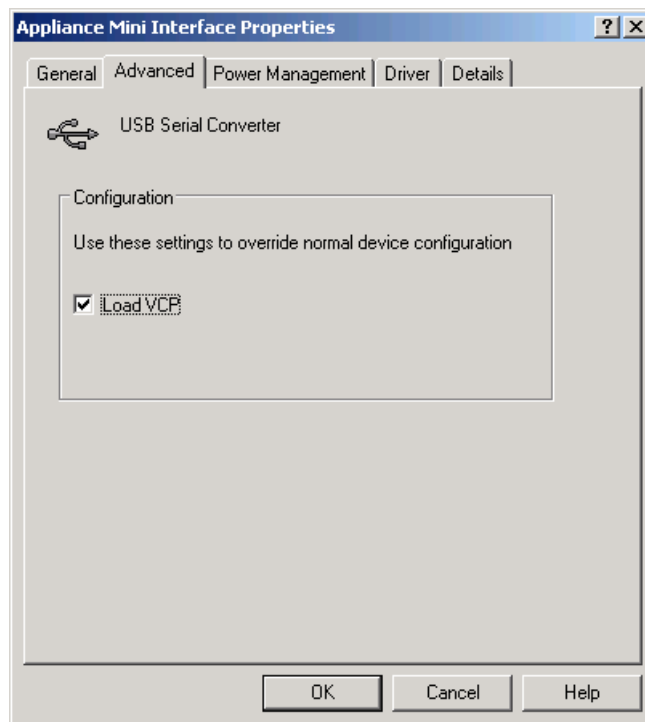


Fig. 39. Load VCP Option

The Load VCP option, allows you to enable or enable or disable the creation of the Virtual COM port (VCP) when you connect the device to the PC. By default virtual COM port creation is enabled.

Please remember that VCP support is essential when you use the Electrolux DAAS protocol. For this reason, CTI recommends you to leave this option set.

If you select the Power Management tab, you can override the installation defaults:

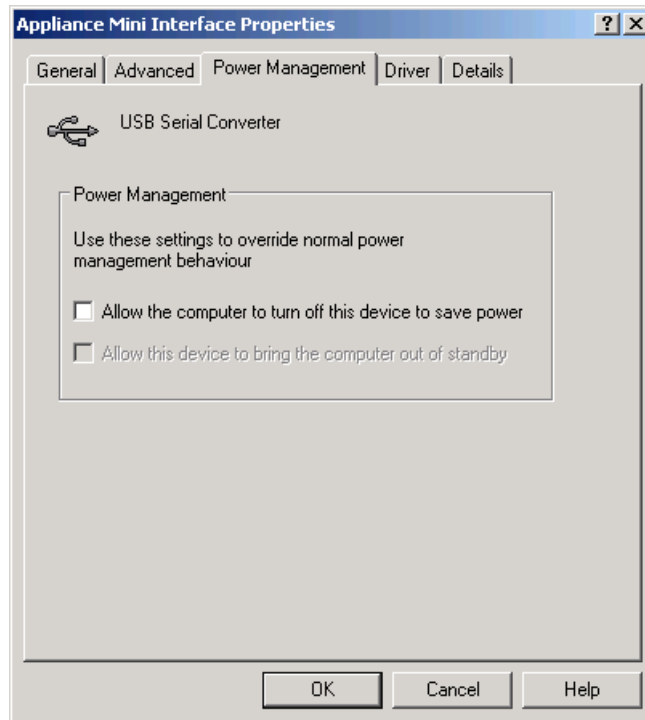


Fig. 40. Power Management Options

The default settings for Power Management are already OK. For this reason, CTI recommends you to leave these options in their default state.

5.7. Uninstalling the USB Drivers

In order to remove the USB drivers of the AMI disconnect it from the PC and then launch the Control Panel and select the Add/Remove Programs applet. Then locate the “FTDI USB Serial Converter Drivers” entry and remove the corresponding software:

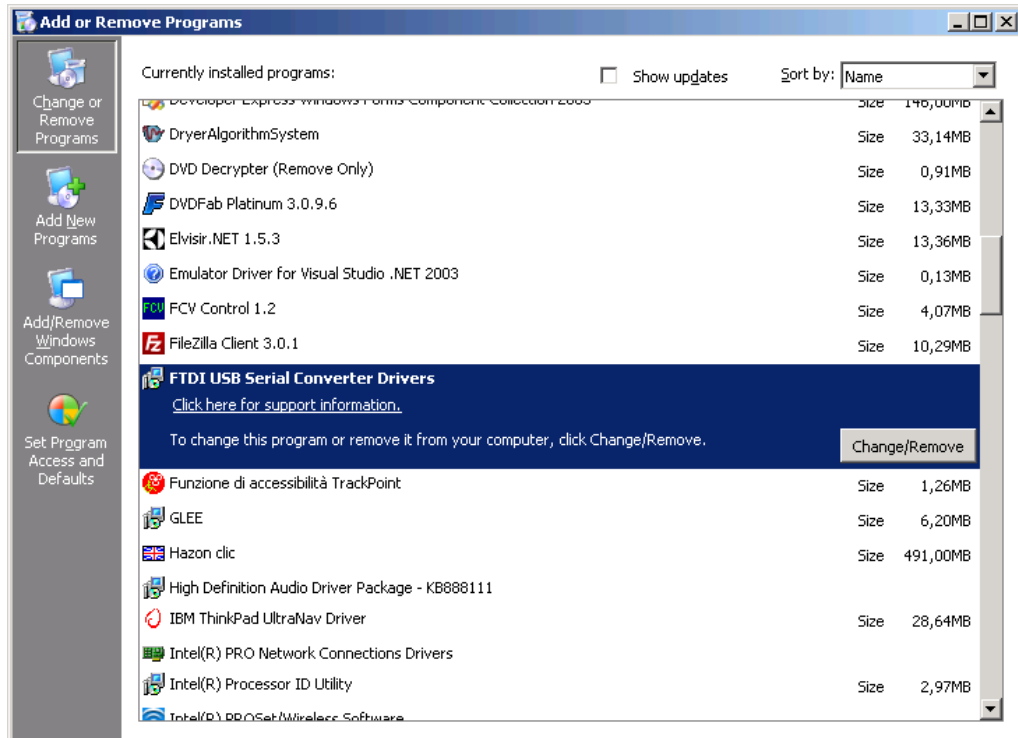


Fig. 41. Removing the USB Drivers

Sometimes the “Add/Remove Programs” utility doesn’t work correctly and the drivers are not removed from the system. To solve this problem you can use the **FTClean** utility provided by the FTDI. company. You can download the latest version of the FTClean utility from this URL: <http://www.ftdichip.com/Resources/Utilities.htm>.

6. ELECTRICAL CHARACTERISTICS

This chapter provides detailed information about the typical electrical characteristics of the AMI module. CTI performed the electrical characterization on an AMI version 3 module with 8-Way plug. Please remember that the actual characteristics may slightly change among different samples.

6.1. POWER SUPPLY

The maximum absolute range for the external power supply is from 7.5VDC to 12VDC unregulated.

The recommended power supply value is 9VDC unregulated.

AMI module automatically uses the external power supply when you connect the corresponding connector.

6.2. TYPICAL OUTPUT POWER – Absolute maximum ratings

AMI is able to provide to the target board a regulated +5VDC power supply. The maximum current that is possible to absorb from the interface is determined by AMI internal circuit and power supply mode:

- **External power supply:** MAX253 maximum power consumption, LM340MP-5 and LE50ABZ output current limit values like explained hereafter.

6.2.1. AMI Power in:

LM340MP-5 (National Semiconductor) voltage regulator: package SOT-223. Datasheet parameters:

- T_J range : 0 ÷ 125 °C
- T_A range : 0 ÷ 125 °C
- Thermal shutdown occurs if $T_{DIE} > 150^\circ\text{C}$
- Input voltage required to maintain line regulation: minimum 7.5V (@ $T_J = 25^\circ\text{C}$, $I_O < 1\text{A}$) for $V_{OUT} = +5\text{V}$ and $V_{IN} = +10\text{V}$ (nominal). So this value cannot be considered valid in general but may vary depending on test situation or sample under test
- The maximum allowable power dissipation at any ambient temperature is a function of the maximum junction temperature for operation (here $T_{JMAX} = 125^\circ\text{C}$), the junction-to-ambient thermal resistance (θ_{JA}), and the ambient temperature (T_A) according to:

$$P_{DMAX} = \frac{(T_{JMAX} - T_A)}{\theta_{JA}}$$

If this dissipation is exceeded, the die temperature will rise above T_{JMAX} and the electrical specifications do not apply

- If SOT-223 is used, the junction-to-ambient thermal resistance θ_{JA} is 174°C/W
- It's supposed a standard T_A of 25°C

The maximum power dissipation for this component can be therefore calculated under the above mentioned conditions that is $P_{D_{MAX}}=0.574W$. Then maximum output current for different values of V_{IN} can be listed, considering a gain factor $g=0.8$:

V_{IN}	ΔV to 5V	$I_{OUT_MAX} = \frac{P_{D_{MAX}}}{g \cdot \Delta V}$
7.5V	2.5V	287mA
9V	4V	179mA
12V	7V	102mA

Table 6.1

MAX253CSA+ (Maxim) power-driver designed to provide isolated power to the circuit. Datasheet parameters:

- T_J max : 150 °C
- T_A range : 0 ÷ 70 °C
- The maximum allowable power dissipation is 1W

6.2.2. AMI Power out:

LE50ABZ (STM) fixed positive voltage regulator. Datasheet parameters:

- Output current limit : 150mA min
- T_J range : -40 ÷ 125 °C
- T_A range : -40 ÷ 125 °C
- Dropout voltage (@ $I_O = 100$ mA): typ. 0.2V

Summarizing, output current limit is fixed to 150mA given by LE50ABZ. Above this value, and particularly for external +12V supply, power consumption of LM340MP-5 rises over $P_{D_{MAX}}$ with a consequent increase of junction temperature even up to $T_{J_{MAX}}$ causing component thermal shutdown; for example if $I_{out}=200mA$ and $V_{in}=12V$, $P_D=1.12W$, 546mW above calculated limit.

- **PC laptop supplied by battery** (+5V [V_{CC}] tolerance is $\pm 5\%$) like worst case for USB AMI feeding.

Like in the situation explained previously LE50ABZ limits output current value to 150mA. Above this value output voltage falls down drastically like displayed in Table 6.2 and chart in Fig. 32 due to “not stabilized” +5V voltage supplied by laptop battery.

6.3. VOLTAGE vs. CURRENT CHARACTERISTICS

Chart in Fig. 42 shows how the output voltage (V_{out}) changes under different current absorption conditions (I_{out}). Different curves indicate the power supply (V_{in}) voltage conditions.

Condition 1: external power supply 7.5V				Condition 2: external power supply 9V			
V_{in}	I_{out} [mA]	V_{out} [V]	I_{in} [mA]	V_{in}	I_{out} [mA]	V_{out} [V]	I_{in} [mA]
7.36V	0	5.02	79.4	9V	0	5.02	86.8
	10	5.01	95.8		10	5.01	100
	20	4.99	110		20	5	113
	30	4.987	124		30	4.99	127
	40	4.977	139		40	4.98	141
	50	4.968	152		50	4.97	155
	60	4.955	165		60	4.96	169
	70	4.94	178		70	4.95	181
	80	4.93	192		80	4.94	195
	90	4.92	206		90	4.93	209
	100	4.9	219		100	4.92	222
	120	4.88	246		120	4.89	249
	140	4.85	276		140	4.87	276
	150	4.84	289		150	4.91	288
	160	4.7	302		160	4.9	300
	170	4.69	316		170	4.81	316
	180	4.52	331		180	4.57	332
	190	4.47	343		190	4.4	345
	200	4.31	357		200	4.16	360
Condition 3: external power supply 12V				Condition 4: USB power supply 5V (laptop supplied by battery)			
V_{in}	I_{out} [mA]	V_{out}	I_{in} [mA]	V_{in}	I_{out} [mA]	V_{out}	I_{in} [mA]
11.9V	0	5.02	88	5.11V	0	5.016	101
	10	5.01	100		10	5.007	113
	20	5	114		20	4.996	126
	30	4.99	127		30	4.986	139
	40	4.98	141		40	4.97	151
	50	4.96	154		50	4.96	165
	60	4.96	168		60	4.95	177
	70	4.946	182		70	4.94	190
	80	4.93	195		80	4.86	203
	90	4.92	210		90	4.71	216
	100	4.91	223		100	4.52	229
	120	4.88	250		120	4.127	253
	140	4.86	277		140	3.706	285
	150	4.85	289		150	3.47	298
	160	4.7	305		160	3.21	309
	170	4.4	318		170	2.9	322
	180	4.45	332		180	2.52	333
	190	4.2	346		190	1.96	343
	200	4.05	359		200	0.5	343

Table 6.2 Measured values of V_{out} and I_{in} @ different values of output (load) current

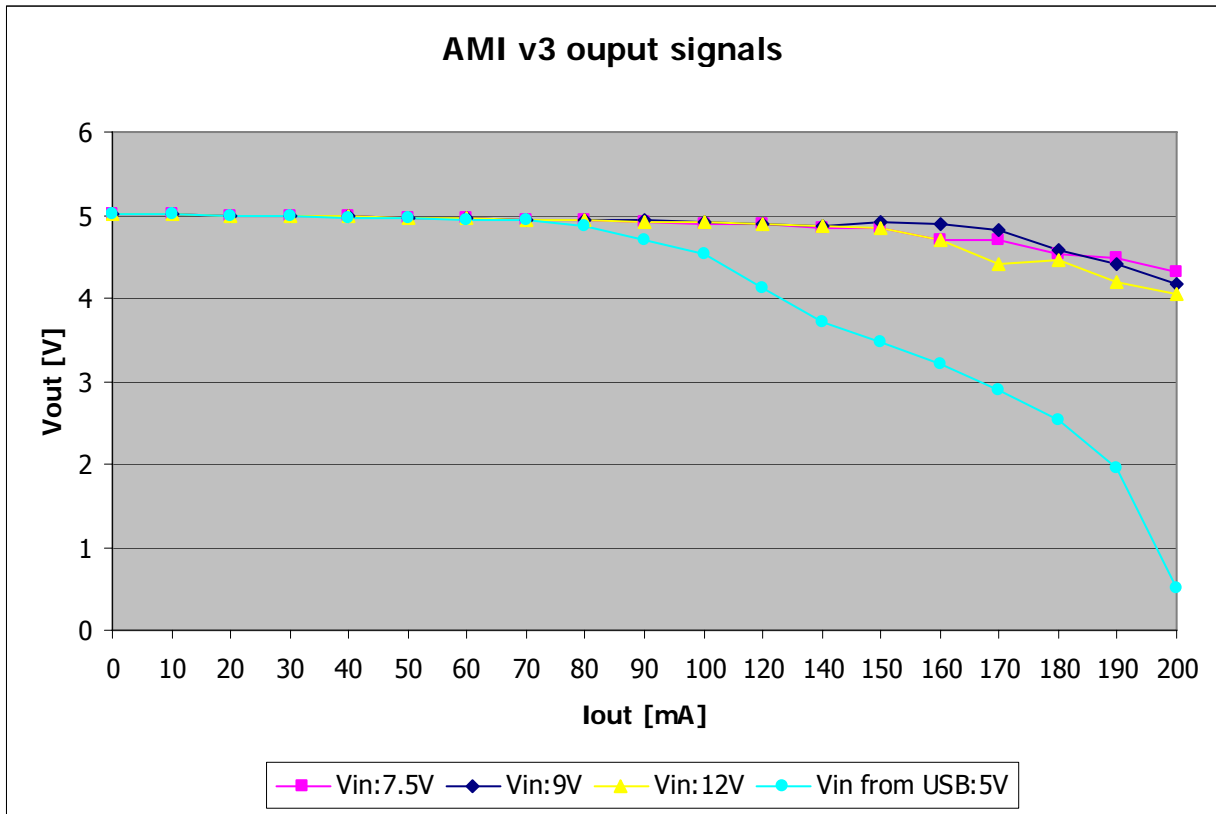


Fig. 42. V_{out} trend for different values of I_{out} and for different V_{in} – note that I_{out} maximum to have a stable V_{out} is 150mA in agreement with LE50ABZ parameters above if external power supply is provided, about 100mA for USB power supply

6.4. CURRENT CHARACTERISTIC

Chart in Fig. 43 displays how the power supply current (I_{in}) absorbed by the AMI changes under different load conditions (I_{out}).

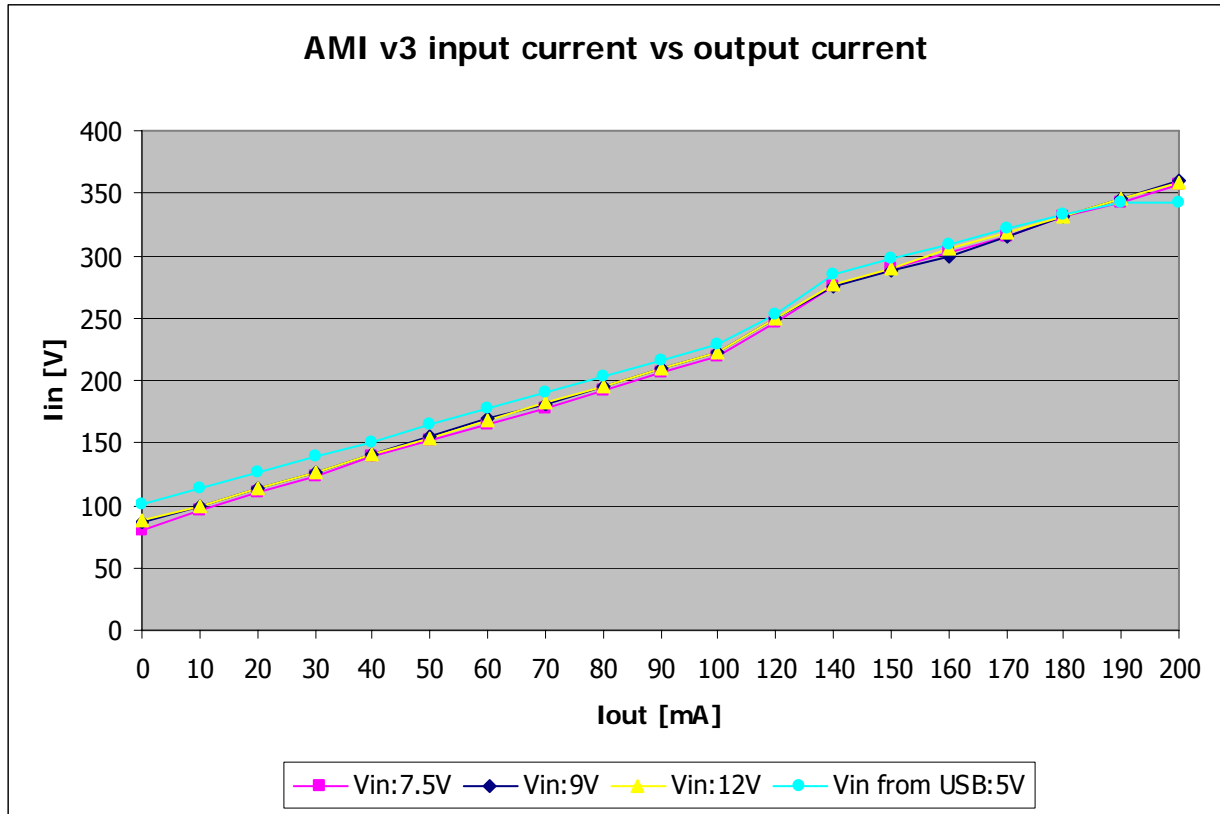


Fig. 43. Nearly linear ratio between I_{out} and I_{in} for different conditions of power supply