iTrack, LLC

Positioned for the Future

Autonomous Vehicle Controller

Installation Instructions
&
Operator User Guide

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HEADQUARTERS: 2200 NORTH SQUIRREL ROAD • ROCHESTER, MICHIGAN 48309 • USA
PHONE: (248) 648-4777 • FAX: (248) 648-4799 • HTTP://WWW.ITRACK-LLC.COM

INTRODUCTION

This manual describes the installation and operation of the Autonomous Vehicle Controller (AVC) for an Omni-directional vehicle from Vetek.

The AVC can be used in local control mode, or in tele operation mode through a PC wireless network configuration.

iTrack is not responsible for any damage that may be caused to or by the vehicle, or any injuries or harm that may be caused by the vehicle when operated by the AVC.

During installation, it was observed that a pin of the AVC connector may not be properly seated in the connector housing, resulting in a fault during initialization of the vehicle. An unpredicted disconnect of this pin during operation would make the vehicle move uncontrollable, and an E-Stop intervention will be required. It is therefore very important to check that all connections of all pins are solid and sound.

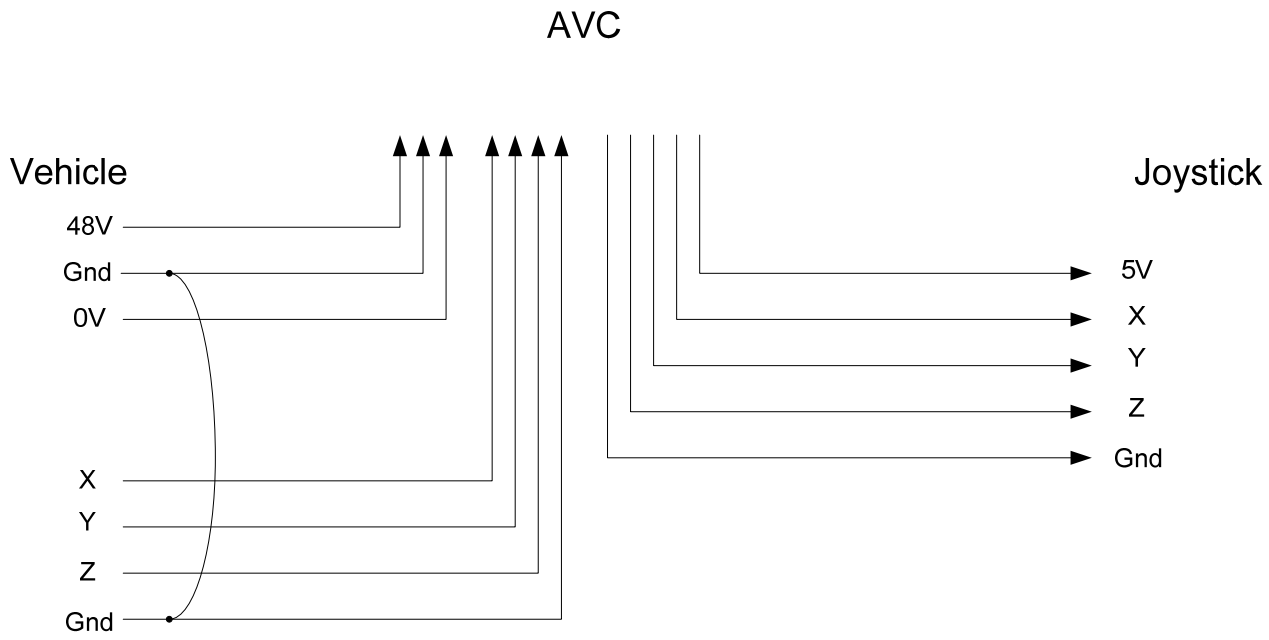
This AVC is a prototype system to be used for demonstration purposes only. iTrack will not produce and deliver any more AVC's of this prototype version. Upon request, iTrack will gladly quote the upgrading and manufacturing of a next generation of this AVC.

Please contact Jerry Atkinson (Jerry.Atkinson@itrack-llc.com) or
Edzko Smid (Edzko.Smid@itrack-llc.com) for any further information.

Table of Contents

INSTALLATION

The AVC is installed inline with the vehicle joystick controller.



CONNECTOR ASSEMBLIES

From Joystick		To AVC			
	6 circuit socket 1-50781-8 (female pins)	6 circuit plug 1-350715-8 (male pins)	Color	Description	AVC Connector pin
White/Red	1	1	white	+5 Volts	B11
	2	2			
White/Black	3	3	black	ground	B12
orange	4	4	orange	joystick x axis in	B2
brown	5	5	green	joystick y axis in	B14
gray	6	6	yellow	joystick z axis in	B3

Joystick Connector

From AVC		To Vehicle			
	6 circuit plug 1-350715-8 (male pins)	6 circuit socket 1-50781-8 (female pins)	Color	Description	AVC Connector pin
N/C	1	1	Red		
N/C	2	2			
black	3	3	black	ground	**B1**
orange	4	4	orange	joystick x axis out	B25
green	5	5	brown	joystick y axis out	B37
yellow	6	6	white	joystick z axis out	B26

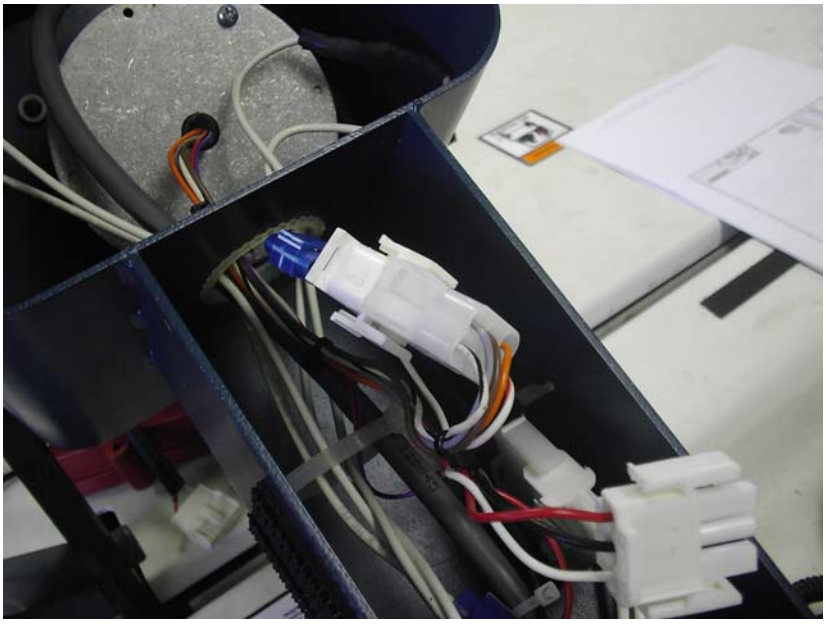
Power Connector

From AVC		To Vehicle			
	3 circuit socket 2-480701-0 (female pins)	3 circuit plug 2-480700-0 (male pins)	Color	Description	AVC Connector pin
White	1	1	White	Tie to vehicle side of **B1**	C30
Black	2	2	Black	To vehicle ground (near motors)	B16
Red	3	3	Red	+48V Input	C23

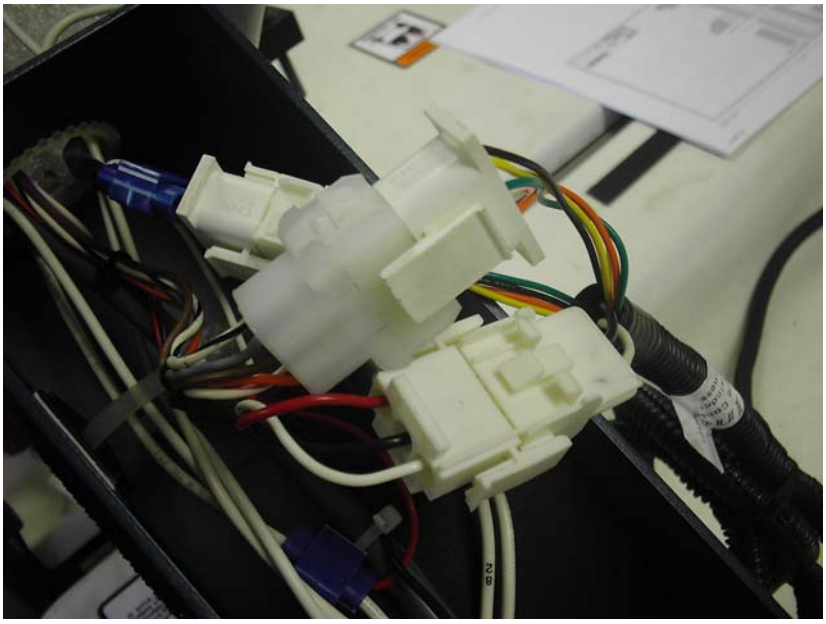
Note: Pin 2 of the Power connector ("to vehicle ground") may not be needed. You may try to operate without this connection first.

The following two photos illustrate how the AVC is installed under the arm-rest of the Airtrax Sidewinder vehicle at iTrack. The gender and pin assignment of the connectors are configured to be able to run the vehicle without the AVC installed.

The first photo shows the vehicle without the AVC connected. The joystick 6-pin connector is connected directly to the vehicle 6-pin connector. The vehicle power connector is not used.



The second photo illustrates the AVC installed. It can be clearly seen how the AVC operates inline with the joystick vehicle control.



OPERATING MANUAL

LOCAL VEHICLE OPERATION

When the PC is not used and the AVC is not connected to a wireless network, then the vehicle is controlled with the onboard pendent and vehicle joystick only.

By default the system engages the manual mode for operating the vehicle with the joystick. The pendent can be used to engage recording, playback etc. Connecting the pendent to the AVC is not required for manual operation of the vehicle. The functions for compressing, reversing, loading and storing recordings are not supported by the pendent.

USING OPERATING MODES

When the system is switched on, the pendent shows the manual mode as follows:

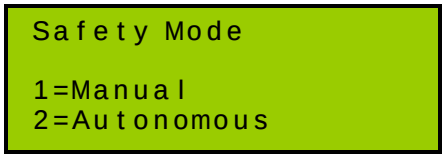
```
Manual Mode  Rev 2
1.00 1.00 90.0
4=Record 7=Playback
#=Safety
```

The numbers "1.00 1.00 90.0" indicate the vehicle's X-position, Y-position and Heading respectively. Note that this position is estimated based on tracking the wheel rotation only.

From the Manual mode, the operator is able to record a movement, to playback a previously recorded movement, or to switch the system into Safety mode.

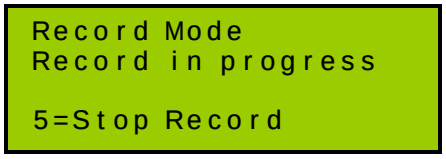
To switch to Safety mode, the operator must issue the "#" command. This is entered in the pendent by first pressing the SHIFT key (LED will light), and then pressing the '#' key. Note that the Shift key does not automatically disengage. The operator must click the SHIFT key again to release (LED will go off).

In Safety mode, the system is parked and the joystick is disengaged. The screen of the pendent shows the following screen:



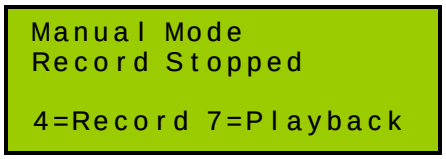
From the Safety mode, the operator is able to engage the Manual mode, or the Autonomous mode. The autonomous mode requires sensors for range finding (e.g. LIDAR) or an absolute position tracking system. Without these sensors, the system should not be operated in Autonomous mode. The manual mode provides for recording and playing back a path based on dead-reckoning.

To record a path, press "4" from the Manual mode. The system will immediately start recording the drive commands at regular intervals. The display of the pendent will show the following screen:

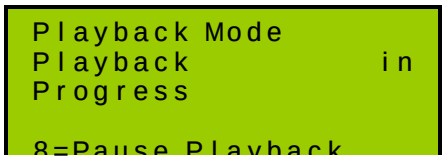


When the movement to be recorded is complete, press "5" to stop and store the recording in memory. When the recording reaches its maximum size the system will automatically stop the recording and store it in memory.

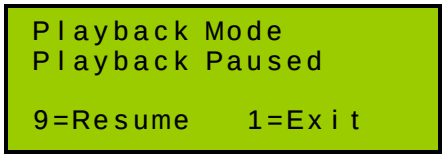
The system is back in the Manual mode. The display of the pendent will show the following screen.



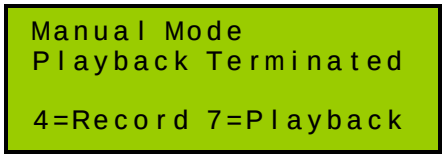
To playback a recording that is currently stored in memory, press "7" from the manual mode. The recording will start to play immediately. The display of the pendent will show the following screen.



The recording can be paused during playback. When paused, the exercise can be aborted by pressing "1" for exit. To continue with the playback, press "9" in playback mode.



Pressing "1" will bring the system back in the Manual mode.



Or the operator can choose to playback the recording another time. When the movement is completed, the screen of the pendent will show the following screen:

```
Playback Mode
Playback Complete

1=Quit  7=Playback
```

When the PC remote operator interface is connected, additional functions will be available for the operator. These functions require the recorded movement to be transferred from and to the AVC.

Uploading a recording from the AVC perspective will transfer the movement from the AVC to the PC. During the upload, the screen of the pendent will show the following:

```
Safety Mode
Upload in Progress
```

The user should not interfere by changing the operating mode during this process until it is completed

```
Safety Mode
Upload Complete
```

Similarly, to download a recording from the PC to the AVC, the screen will look as follows:

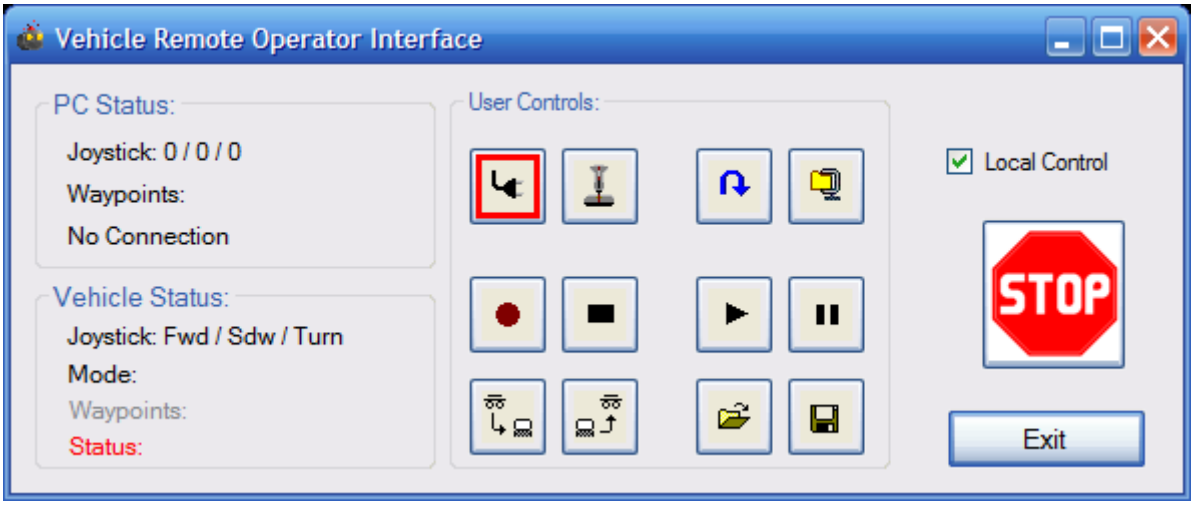
```
Safety Mode
Download          in
Progress
```

```
Safety Mode
Download Complete
```

TELE-OPERATION OF THE VEHICLE

Tele-operation of the system is conducted through a Pentium-PC running the Windows operating system. The communication between the PC and the vehicle takes place through a standard wireless Ethernet network. A pre-configured Netgear router is provided along with the AVC that supports the communication. When the router is powered up, the PC should find the router under the SSID name "PAVILION". When powered up, also the AVC will logon to the network called "PAVILION".

The PC Operator Control Interface consists of a windows application, and a standard USB joystick. The graphical user interface of the program is shown below.



 Connect or disconnect to the AVC through the wireless network. When the red rectangle in the button turns green, then the connection is established.

Many of the manual operations are identical to the operations on the pendent. In fact, the display of the pendent will constantly show the current operating mode of the system.

 Engage manual control. The system must be in Safety mode before manual mode can be engaged.

 Engage manual recording mode. The manual drive commands are stored in memory in the AVC during this mode. Any previous recordings will be erased. The system must be in manual mode before the recording mode can be engaged.

 Stop manual recording mode.

 Play the current recording in the AVC.

 Pause the current playback. Press again to continue.

Stop the vehicle and set Safety mode.

The Operator Interface program on the PC has additional features to complement the operation of the AVC. To work with movement recordings, the user must always keep in mind where the active recording is located.

Recording and playing back implies the recording to be stored on the AVC.

Storing to file, or loading to file or reversing and compressing a movement imply the recording to be stored on the PC.

In other words: To record a movement and play back the compressed movement, the operator must do the following sequence:

1. Manually record the movement
2. Download the movement recording to the PC
3. Compress the recording
4. Upload the recording back to the AVC
5. Playback the newly uploaded recording

To playback a previously stored recording on the AVC:

1. Load a recording from file into the PC
2. Upload the recording from the PC to the AVC
3. Press Playback to play the recording currently in the AVC

The buttons in the Operator Interface that are associated with these additional features are listed below.

 Download the current recording from the AVC to the PC.

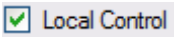
 Upload the recording from the PC to the AVC.

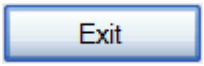
 Reverse the recording in the PC.

 Compress the recording in the PC.

 Load a recording from file into the PC.

 Store the current recording in the PC to a file on disk.

 When this box is checked, select the USB joystick on the PC as the manual control interface for the vehicle. If this button is not checked, then the local joystick on the vehicle is used to control for manual control.

 Disconnect the AVC and exit the operator interface program.

NOTES:

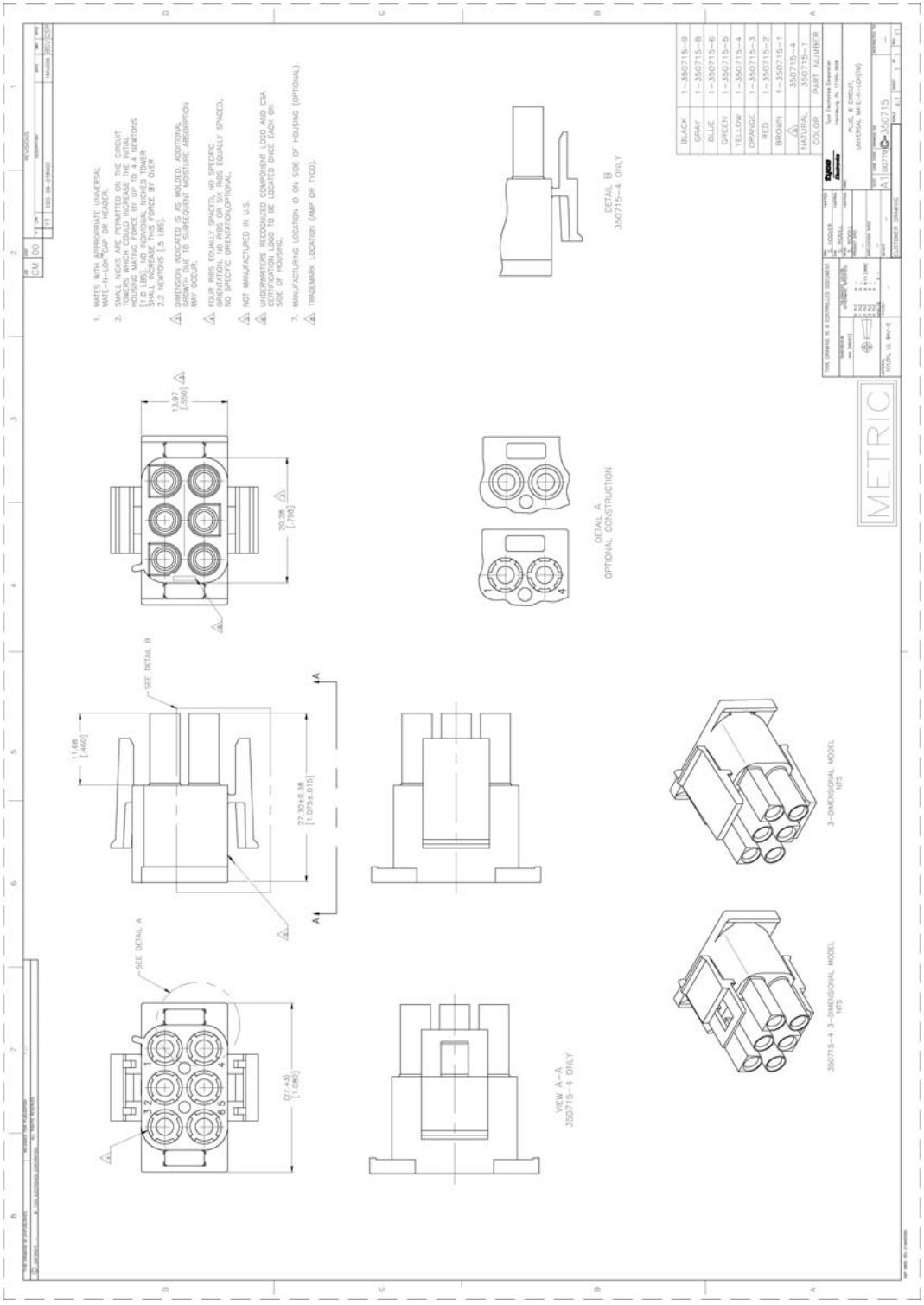
- The AVC can only store one recorded movement. Recording another movement will erase the previously recorded movement. To store multiple movements, the operator must transfer each movement to the PC and store it to file.

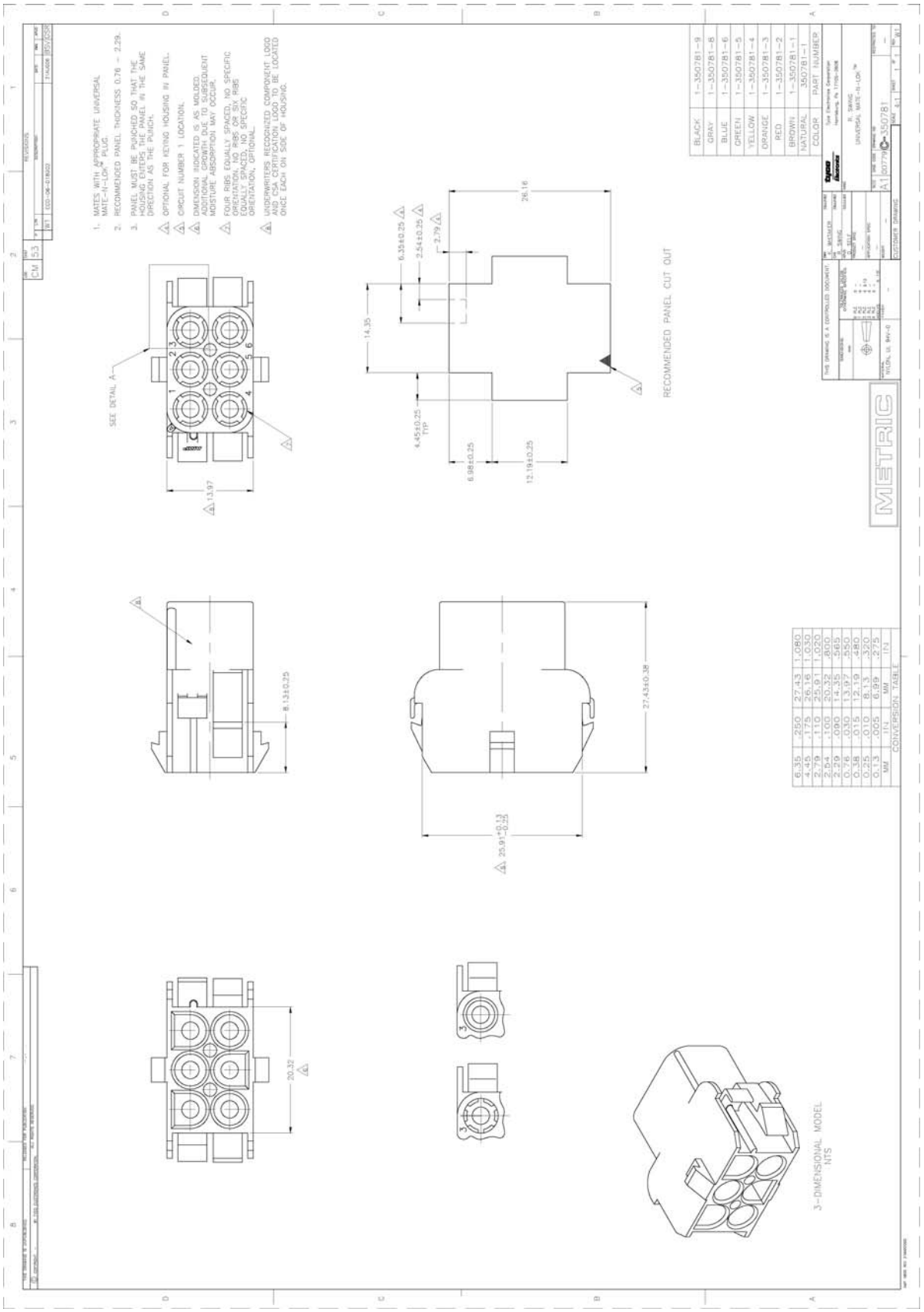
- Compressing or reversing a movement will result in loss of accuracy in repeatability compared to the originally recorded movement. Compressing a movement will eliminate the times when the vehicle is not moving. Reversing a movement will generate commands that are opposite to the recorded commands. This operation assumes that the vehicle performs exactly symmetrically with respect to joystick operation.

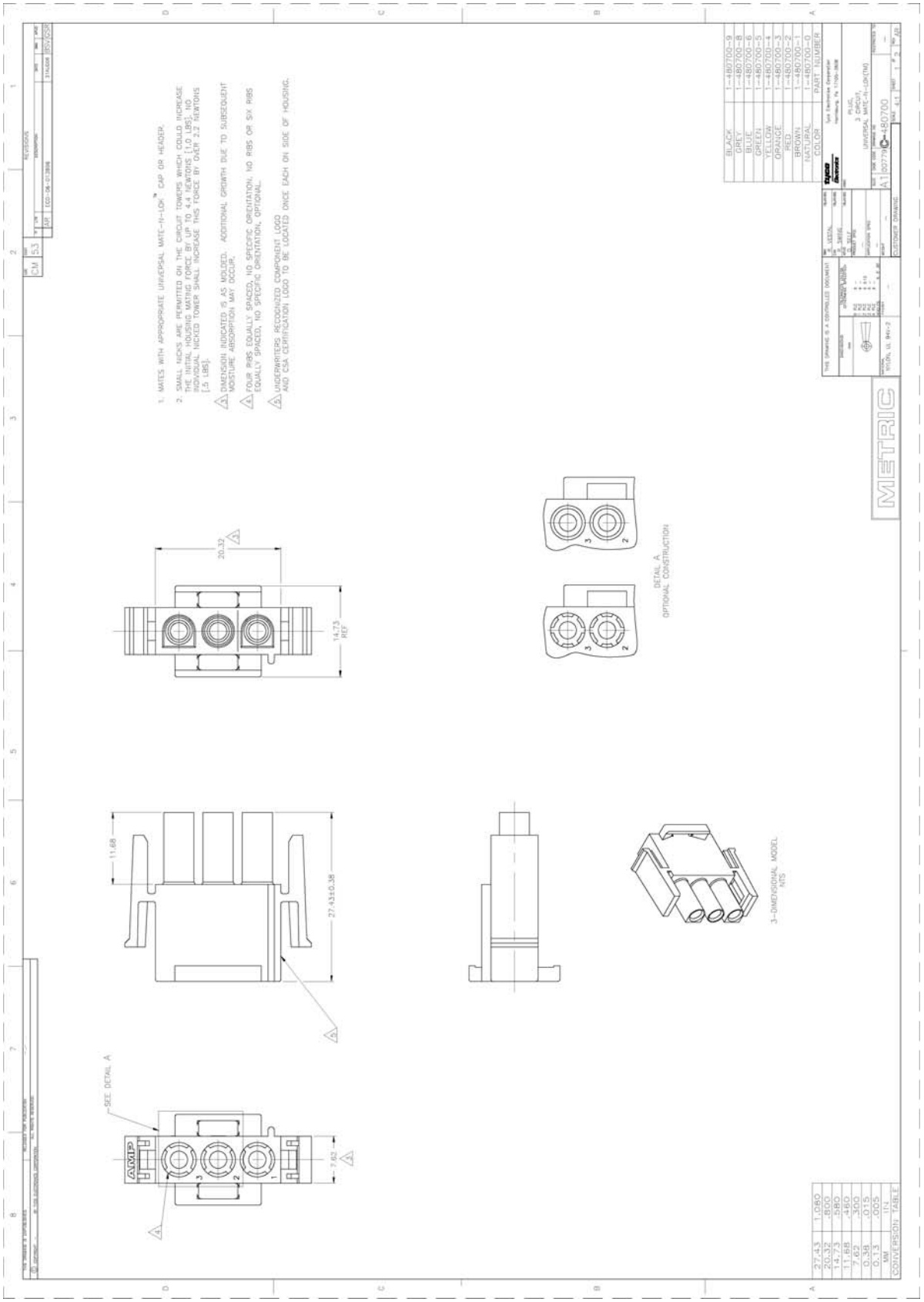
APPENDIX A – PART LIST

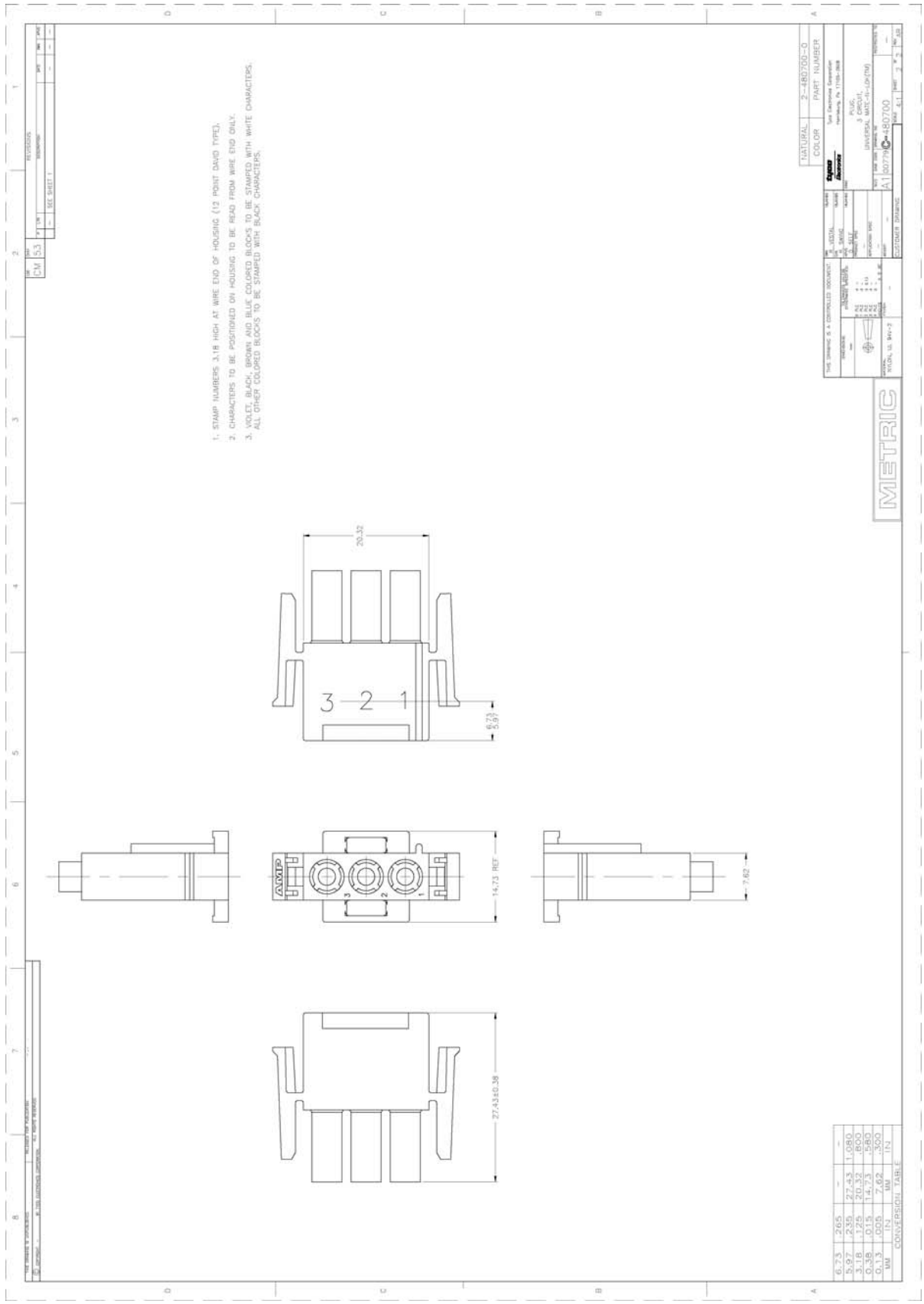
1. Autonomous Vehicle Controller
2. Harness
    a. AVC – ODV
    b. AVC – Pendent
3. Pendent
4. Router + adapter
5. Discrete AMP connector housings and pins
6. Instructions manual

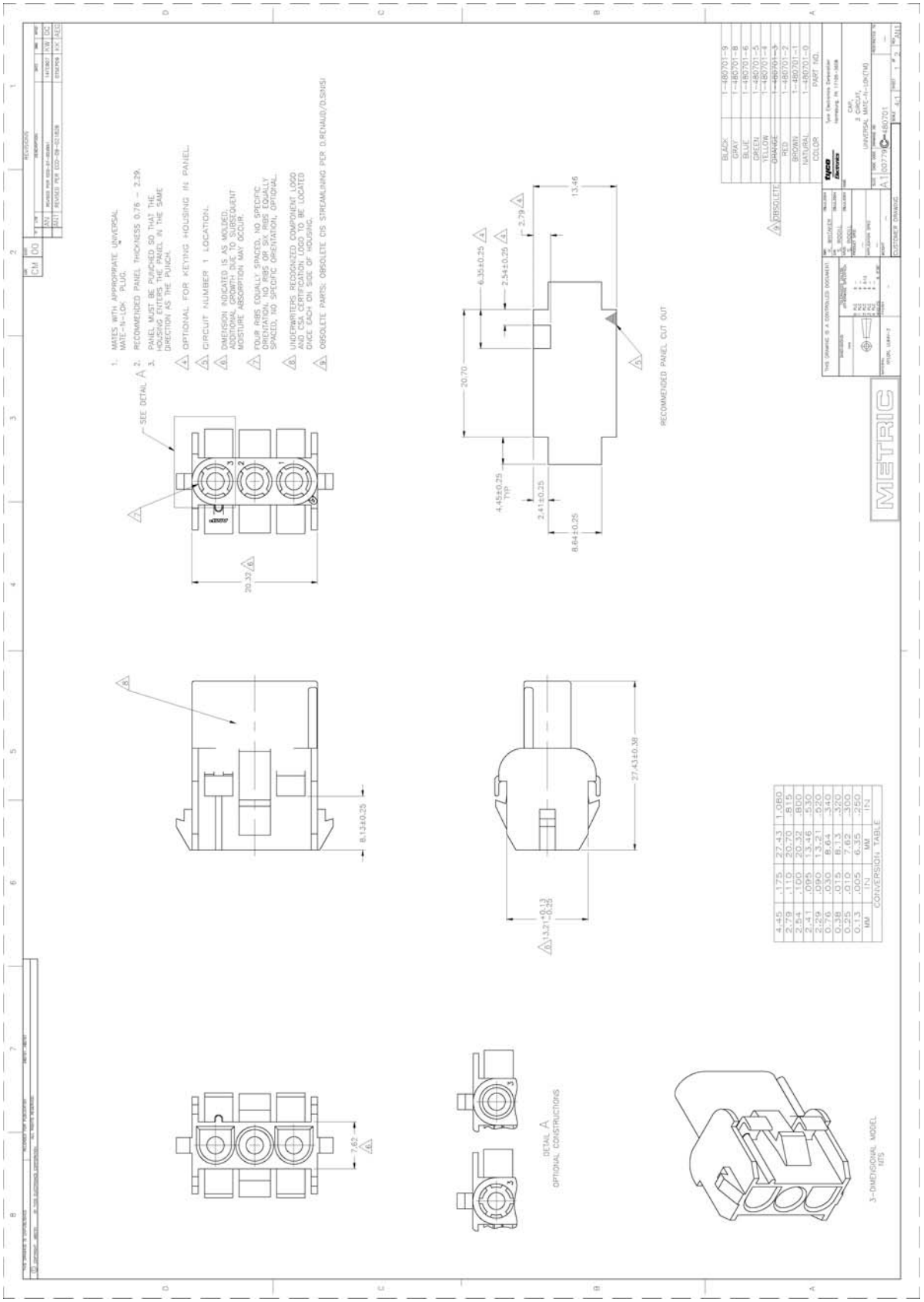
APPENDIX B - CONNECTOR DATA SHEETS

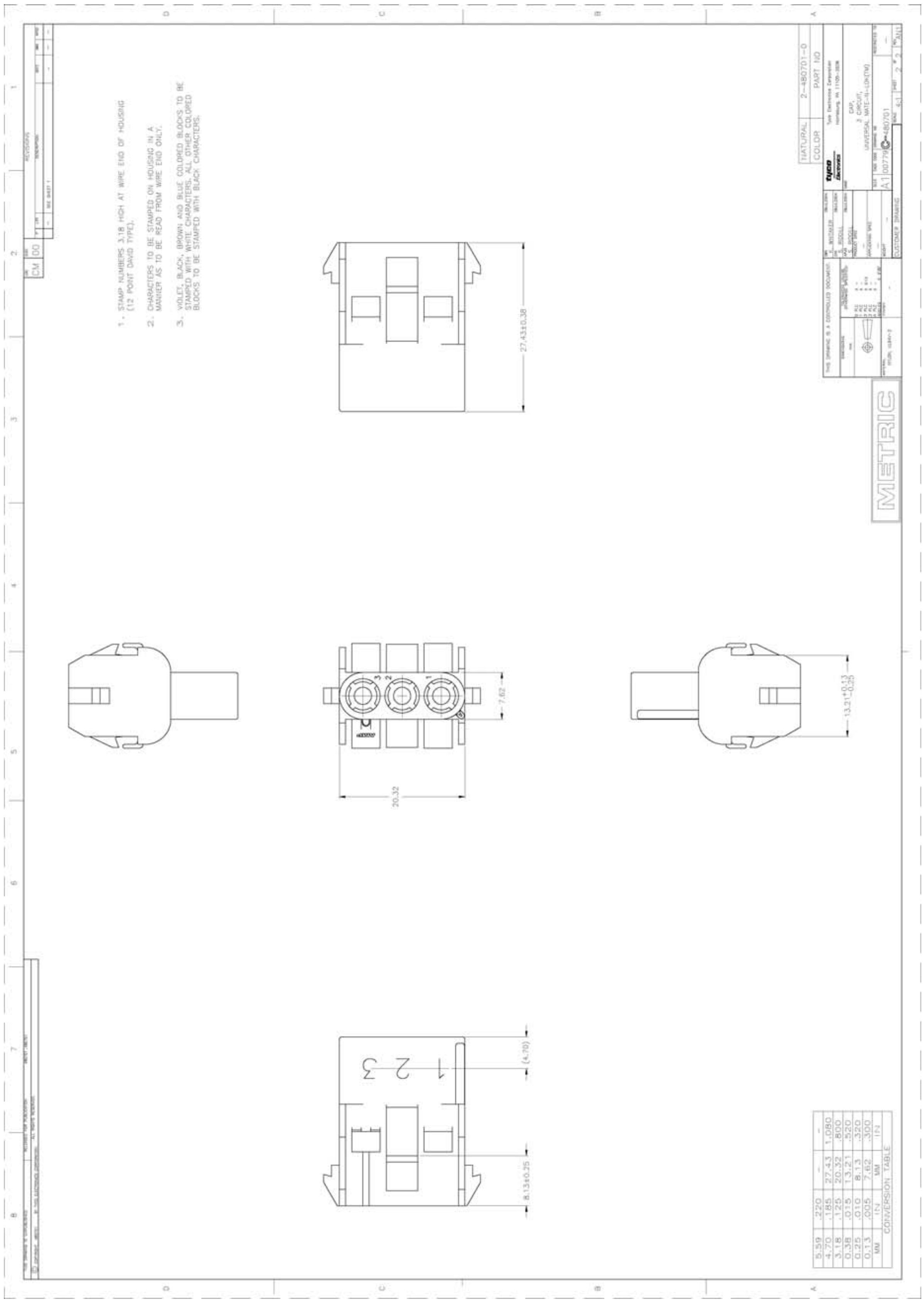



1. MATES WITH APPROPRIATE UNIVERSAL MATE-N-LOK™ PLUG.
2. RECOMMENDED PANEL THICKNESS 0.76 – 2.29.
3. PANEL MUST BE PUNCHED SO THAT THE HOUSING ENTERS PANEL IN THE SAME DIRECTION AS THE PUNCH.
OPTIONAL FOR KEYING HOUSING IN PANEL.
CIRCUIT NUMBER 1 LOCATION.
DIMENSION INDICATED IS AS MOLDED. ADDITIONAL GROWTH DUE TO SUBSEQUENT MOISTURE ABSORPTION MAY OCCUR.
FOUR RIBS EQUALLY SPACED, NO SPECIFIC ORIENTATION. NO RIBS OR SIX RIBS EQUALLY SPACED, NO SPECIFIC ORIENTATION, OPTIONAL.
UNDERWRITERS RECOGNIZED COMPONENT LOGO AND CSA CERTIFICATION LOGO TO BE LOCATED ONCE EACH ON SIDE OF HOUSING.
SEE DETAIL A
RECOMMENDED PANEL CUT OUT
BLACK 1-350781-9
GRAY 1-350781-8
BLUE 1-350781-6
GREEN 1-350781-5
YELLOW 1-350781-4
ORANGE 1-350781-3
RED 1-350781-2
BROWN 1-350781-1
NATURAL 350781-1
COLOR PART NUMBER
METRIC
CONVERSION TABLE
3-DIMENSIONAL MODEL
NTS




1. STAMP NUMBERS 3.18 HIGH AT WIRE END OF HOUSING (1/2 POINT DAVID TYPE).
2. CHARACTERS TO BE POSITIONED ON HOUSING TO BE READ FROM WIRE END ONLY.
3. VIOLET, BLACK, BROWN AND BLUE COLORED BLOCKS TO BE STAMPED WITH WHITE CHARACTERS.
ALL OTHER COLORED BLOCKS TO BE STAMPED WITH BLACK CHARACTERS.
NATURAL
COLOR
2-480700-0
PART NUMBER
METRIC
20.32
3 2 1
6.73
5.97
14.73 REF
7.62
27.43±0.38
AMP
6.73 .265 –
5.97 .235 27.43 1.080
3.18 .125 20.32 .800
0.38 .015 14.73 .580
0.13 .005 7.62 .300
MM IN MM IN
CONVERSION TABLE




1. STAMP NUMBERS 3.18 HIGH AT WIRE END OF HOUSING (12 POINT DAVID TYPE).
2. CHARACTERS TO BE STAMPED ON HOUSING IN A MANNER AS TO BE READ FROM WIRE END ONLY.
3. VIOLET, BLACK, BROWN AND BLUE COLORED BLOCKS TO BE STAMPED WITH WHITE CHARACTERS. ALL OTHER COLORED BLOCKS TO BE STAMPED WITH BLACK CHARACTERS.
27.43±0.38
7.62
20.32
13.21
(4.70)
8.13±0.25
NATURAL
COLOR
2-480701-0
PART NO
METRIC
CONVERSION TABLE

APPENDIX C – AVC SCHEMATICS