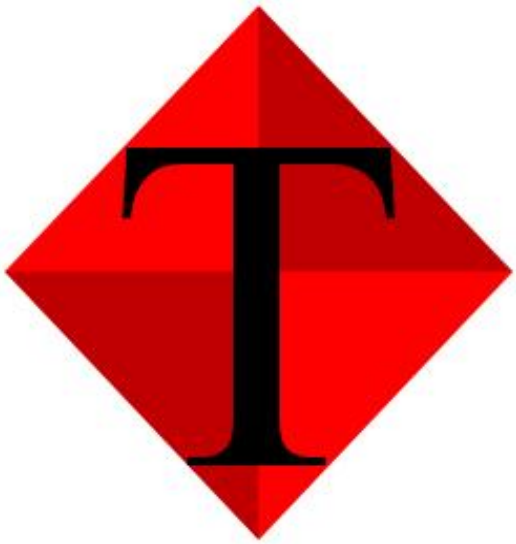
TETRA-DS III™
Operating Manual

Version 1.0



2011.05

Dongbu Robot

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Important Safety Instructions

- Make sure to read the instruction manual before operating the Terra-DS III.
- Do not increase the power input beyond the specification.
- Keep away from water and humidity to prevent damage from fire or electric shock.
- Do not disassemble the components or optional parts.
- Do not operate on long haired carpet or fur.
- Do not touch the internal components with the battery installed or while charging..

Inappropriate Operation

Warranty will become null and void if the damage is caused by careless or inappropriate operations. Refer to below for examples of inappropriate/careless operations that may cause damage and void the warranty.

- Operating the robot on top of a table or allowing the robot fall from high area.
- Operating the robot with payload beyond recommended weight.
- Letting the robot become wet.
- Continuing to use the robot with hair, thread, or other similar material wrapped around the wheels, axles, and gears.
- Disassembling or exposing the internal components of the robot without removing the battery first or while the battery is charging.
- All other inappropriate or careless actions that results in damage to the robot.

Chapter 1. Introduction

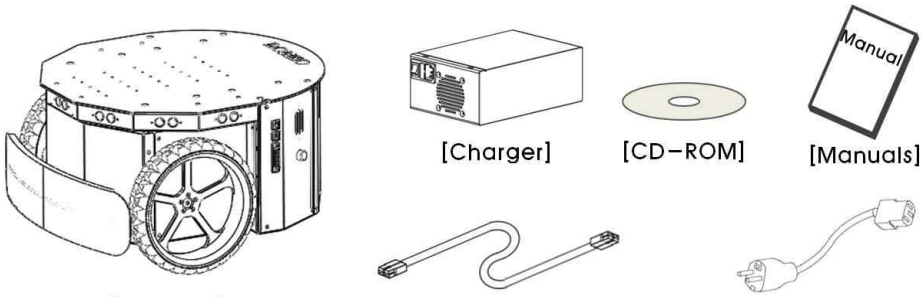
1-1. Platform Packages

TETRA-DS III™' is an advanced indoor robot platform for developing and testing autonomous robot movement technology and programming. TETRA-DS III™ is available in three different models, Basic, Advanced, and Pro. Refer to the diagram 1-1 blow to see the three different available models.

[BASIC] [ADVANCE] [PRO]

<Diagram 1-1> Model Images of TETRA-DS III™

TETRA-DS III™ package is composed of the parts shown in diagram 1-2. When the box is first opened, check to make sure all the parts are included. Contact and notify the local service center for any missing parts.
The package components may change or differ according to the model or version.



<Diagram 1-2> TETRA-DS III™ Package Components

1-1-1. Basic Components

- TETRA-DS III™ Platform
  - DSCP and Battery installed
- Charger Set
  - Charger – All models
  - Charge Board - PRO model only
  - 220V AC Power Cord – all models
  - Charge Cable – BASIC and ADVANCED models have one piece charger without separate charge cable.
- CD-ROM for TETRA-DS III™
  - CD-ROM for TETRA-DS III™ Operation
- Operating Manual
  - TETRA-DS III™ Operating Manual
  - DSSP-HAL Operating Manual

1-1-2. Optional Parts and Accessories

- Laser Range Finder Module
  - HOKUYO社 URG/UHG/UTM series mounting bracket and connection cable

- SICK社 LMS100/200 series mounting bracket and connection cable

■ Fixed Location Sensor Module
- Hagisonic社 StarGazer™ Mounting bracket and connection cable

■ Pan-tilt Camera Module
- Bumblebee 2 Stereo camera, pan-tilt mechanism and connection cables

■ SBC (Single Board Computer
■ USB type Wireless LAN card
■ Replacement batteries
■ Serial Cables for external connection

1-1-3. User-supplied components

■ Usable power ports
- Three 5V ports, Two 12V ports

■ Usable communications port
- One RS-232/485 compatible port

■ Additional power board
- Middle-link board

1-2. Additional Resources

1-2-1. Tech Support Website

Our website is open 24hrs a day 365days a year, providing users with the latest news, updates, and technical info.

http://www.dasarobot.com or http://int.dasarobot.com

Users must log in to access all parts of the website as certain sections are restricted to non -registered users. Please complete and mail the included registration form or register online following the instructions on the website.

1-2-2. Technical Support

Use the site below to share your knowledge and recommendations for improvement or to ask questions if you are running into problems and can't find the answer in the operating manual.

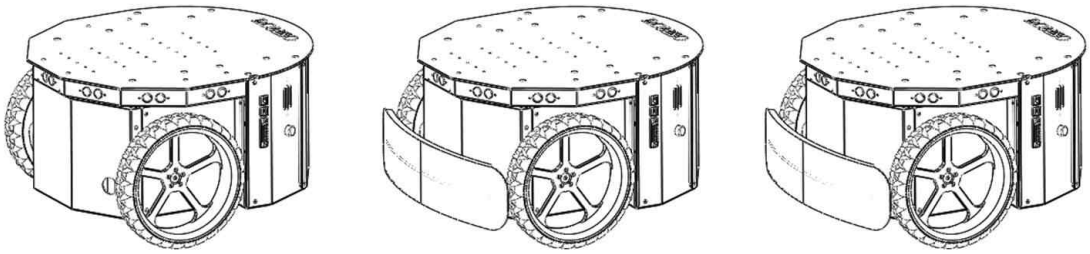
http://www.dasarobot.com/support

Questions or inquires can also be sent by email to the address below.

support@dasarobot.com

Chapter 2. What is TETRA-DS III™?

TETRA-DS III™' is an advanced indoor robot platform for developing and testing autonomous robot movement technology and programming. TETRA-DS III™ is divided into three different models based on the installed Reduction Module, maximum speed, payload, ultrasonic sensor, and etc. Refer to the diagram 2-1 below for comparison chart between the models. Please contact our Customer Support Center or refer to our website for more detailed information concerning each model. Customers considering the purchase of TETRA-DS III™ should choose the appropriate model based on the expected operating environment. Those wishing to change the purchased TETRA-DS III™ to a different model should contact our Customer Support Center.



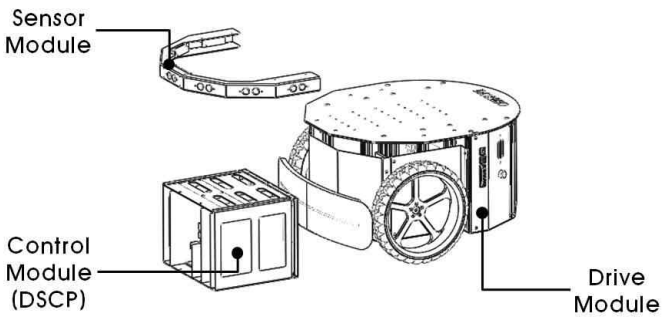
<Diagram 2-1> Model Line-up of TETRA-DS III™

<표 2-1> Comparison Table b/w TETRA-DS III™ Models

ITEMS	BASIC	ADVANCE	PRO
Reduction Module	15:1	15:1	20:1
Max. Speed	2.0m/s	2.0m/s	1.5m/s
Payload	40kg	40kg	80kg
Ultrasonic Sensor Module	Option	Installed	Installed
Bumper Module	Option	Installed	Installed
Embedded Board	Option	Installed	Installer
Battery	24V 7Ah Lead-acid	24V 10A Ni-MH	24V 20Ah Li-PB

2-1. TETRA-DS III™ Modules

TETRA-DS III™ is composed of the Drive Module, Sensor Module, and Control Module as can be seen in the diagram 2-2. The modular design makes future upgrade and expansion easily possible as each module can be upgraded or expanded separately as required. Outdoor robot platform is currently under development and expected to be released soon. Existing TETRA-DS III™ customers wishing to purchase the Outdoor robot platform simply needs to purchase the Drive Module and use the existing Sensor and Control Module. Please contact our Customer Support Center for upgrade information.



<Diagram 2-2> Modules of TETRA-DS III™

2-2. Connecting to TETRA-DS III™

One of the four methods shown in the diagram 2-3 could be used to communicate with the platform. To control various devices installed in the platform, TETRA-DS III™ runs a type of device driver called DSSP-HAL (DaSarobot Software Platform-Hardware Abstraction Layer) service which is a unified TCP/IP communications API (Application Program Interface).

Please refer to the provided "DSSP-HAL Manual" for the details concerning DSSP-HAL service.

(a) Connecting to PC(Desktop) using Ethernet Cable

Communication via the Ethernet cable. The Ethernet cable is connected from the Ethernet port on the PC to the Ethernet port at the side of the TETRA-DS III™.

(b) Connecting to Laptop using Ethernet Cable

Communication via the Ethernet cable. The Ethernet cable is connected from the Ethernet port on the Laptop to the Ethernet port at the side of the TETRA-DS III™

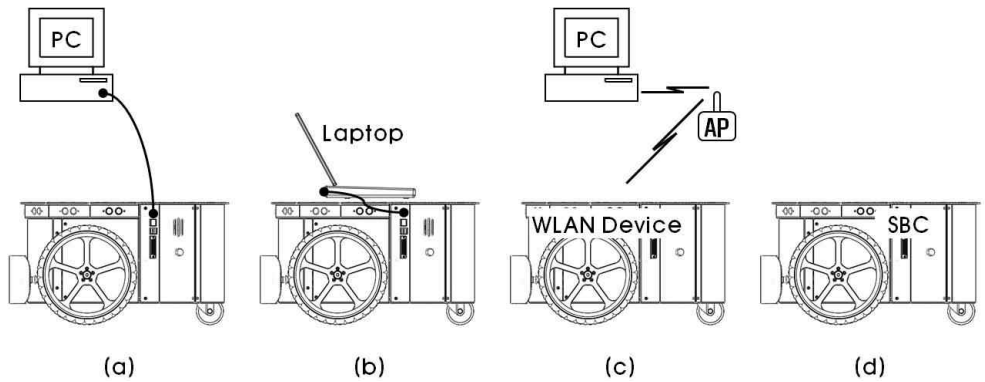
(c) Connecting to PC via Wireless AP (Access Point)

This method uses wireless AP to communicate with the platform. Accessible AP must exist within the operating environment for the communications to occur.

Connect the USB type wireless LAN card to the USB port on the VIA embedded Board in the DSCP. As DSCP operates in Linux, wireless LAN card used requires Linux device driver. Please contact our Customer Support Center if you wish to purchase the optional Wireless LAN card compatible with the TETRA-DS III™. .

(d) Connection with Optionally Installed SBC

The DSCP in the platform can accommodate mini-ATX type SBC (Single Board Computer). This optional SBC can be connected to the VIA embedded Board in the DSCP by connecting the Ethernet ports. Please contact our Customer Support Center if you wish to purchase or enquire about the optionally available SBC.



<Diagram 2-3> Connection to TETRA-DS III™

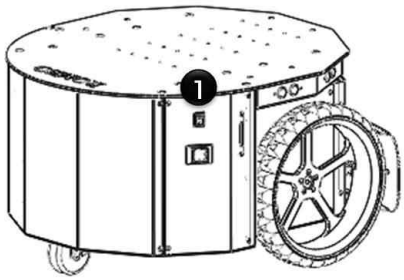
Chapter 3. Quick Start

Follow the steps outlined below if you wish to perform simple basic tests on TETRA-DS III™ after the purchase.

Step 1. Turning on the Main Power

Use the main power switch located on the right side of the platform as shown in Diagram 3-1 to turn the main power ON(①). Once the power is switched ON, the LEDs on the "Status LED window" located on the left side of the platform light up and the buzzer sounds to indicate platform ready status. Blinking LED is an indication of a problem with the platform, Customer Support Center should be contacted and notified.

If the bottom red LED on the LED window starts to blink and the buzzer sounds when the power is turned ON, it is an indication of low battery power and the battery must be first charged using the provided charger before proceeding to the next step. Please refer to the section 5-1-6 "Battery and Charger" for details.

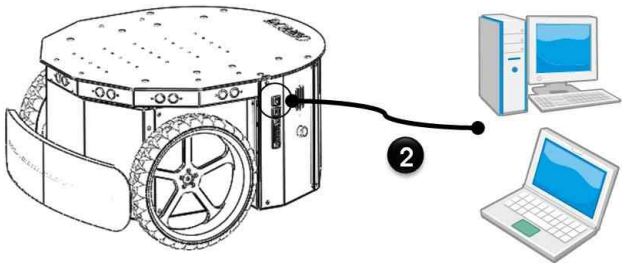


<Diagram 3-1> Turn Main Power Switch ON

Step 2. Connecting to TETRA-DS III™

For the BASIC model, use the USB cable (not provided) to connect② the TETRA-DS III™ from the No 1 USB port located on the left side of the platform to the USB port on the desktop PC or Laptop computer as shown in the diagram 3-2 and diagram 5-4 (a). BASIC model comes equipped with "USB2Serial" converter to connect the platform to the controller.

For ADVANCED and PRO models, use the Ethernet cable (not provided) to connect② the TETRA-DS III™ from the Ethernet Port located on the left side of the platform to the Ethernet port on the desktop PC or Laptop computer as shown in diagram 3-2.



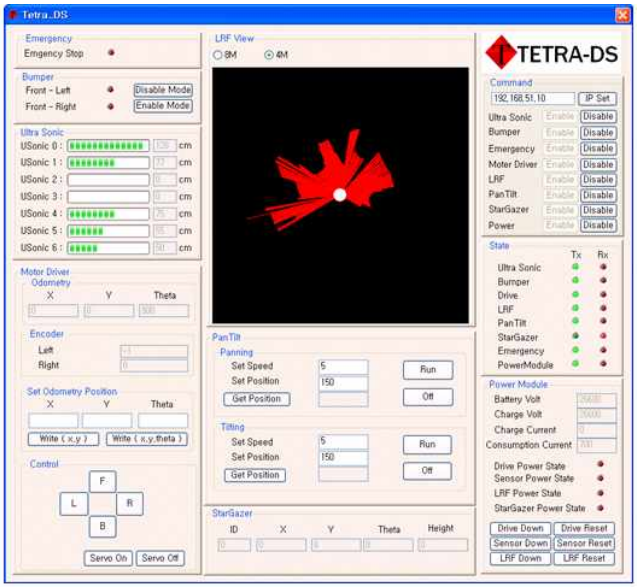
<Diagram 3-2> Connect to TETRA-DS III™ via Ethernet Cable

Refer to the section 2-2. "Connecting to TETRA-DS III™ " for other connection methods.

Step 3. Controlling the TETRA-DS III™ with PMP

Run the included PMP (Platform Management Program) shown in diagram 3-3 to control or check the platform status. Refer to the "PMP Operating Manual" for the detailed instructions.

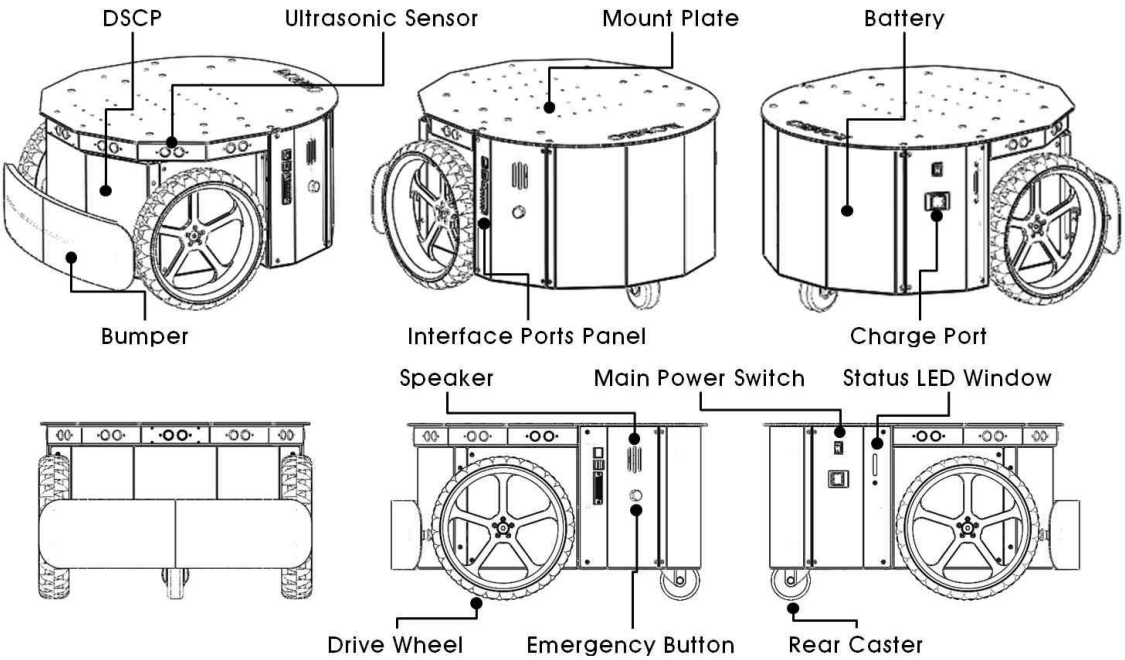
Depending on the program version, actual PMP screen may vary from the diagram 3-3 shown below.



<Diagram 3-3> Execute PMP to Control TETRA-DS III™

Chapter 4. Mechanical Hardware Specifications

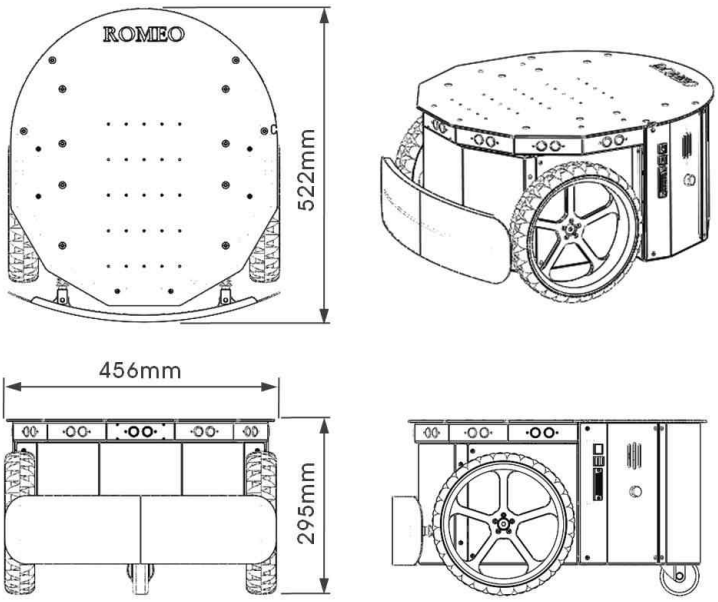
Diagram 4-1 below shows the layout of the TETRA-DS III™ components. ADVANCED and PRO models use the differential drive and highly efficient AC Servo Motor for improved speed and payload handling. The collision detection bumper (sold separately on basic model) is attached to the front bottom of the platform. The top of the platform has number of mounting holes to install various sensors and devices required for developing and testing autonomous movement programming. The interface ports for communicating with and controlling the installed devices and sensors are located on the left side. The top front half of the platform has various sensors mounted to detect obstacles. Emergency stop button and the speaker (speaker only in PRO model) is also located on the left side of the platform.



<Diagram 4-1> Components Layout of TETRA-DS III™ (ADVANCE & PRO)

The external dimensions of the platform are shown on the diagram 4-2.

Chart 4-1 shows the mechanical specifications of the TETRA-DS III™. Please contact our Customer Support Center if you require more detailed technical information.

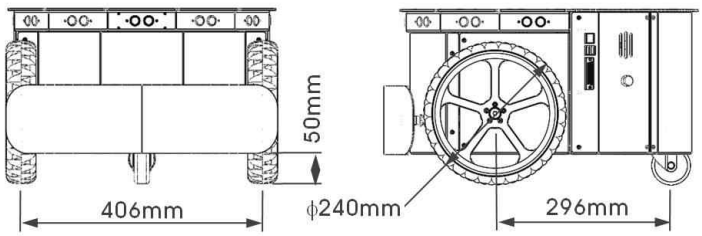


<Diagram 4-2> Physical Dimensions of TETRA-DS III™ (ADVANCE & PRO)

<Chart 4-1> Mechanical Specifications of TETRA-DS III™

ITEMS		BASIC	ADVANCE	PRO
Body	External Size	L502×W456×H295mm	L522×W456×H295mm	
	Weight	Below 20kg		
Locomotive section	Movement Type	2-Wheel Differential Drive (AC Servo Motor)		
	Speed	max. 2.0m/s		max. 1.5m/s
	Gear Reduction Ratio	15:1		20:1
	Payload	40kg		80kg
	Axle Track	406mm		
	Clearance	50mm		
Wheels	Wheel diameter	240mm		
	Wheel width	50mm		

The external dimensions of the locomotive mechanism attached to the platform are shown on diagram 4-3.



<Diagram 4-3> Dimensions of Locomotive Mechanism

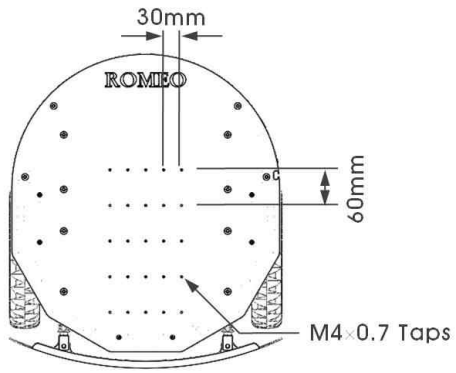
4-1. Components

- Mount Plate
- Bumper Mechanism

- Motors and Encoders
- Caster

4-1-1. Mount Plate

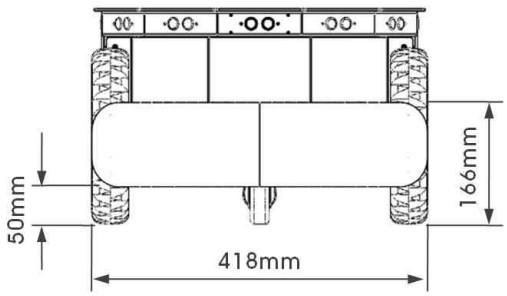
Various sensors such as Laser Scanners, Position Sensors, Stereo Cameras, and other devices required for developing autonomous movement can be mounted on top of the TETRA-DS III™ "Mount Plate". Mount Plate has number of pre-drilled mount taps (holes) to make installing devices and sensors easier. Brackets for mounting some of the common sensors are available for sale separately. Please contact our Customer Support Center to enquire about mounting brackets for other less common sensors and devices.
Refer to the Diagram 4-4 to view the mount tap positions and dimensions.



<Diagram 4-4> Dimensions of Taps on Mount Plate

4-1-2. Bumper Mechanism

The bumper mechanism for detecting collision with an obstacle comes installed on the ADVANCED and PRO model (Sold separately for BASIC model) of the TETRA-DS III™. Two collision sensors are used to detect and determine the position of the collision. The sensors will detect collision from three different positions, Front, Left, and Right. The dimensions of the bumper mechanism are shown on the diagram 4-5 below. The ability of the bumper mechanism to determine the location of the collision may vary depending on the collision condition. Please contact our Customer Support Center if you require more technical information concerning the bumper mechanism.



<Diagram 4-5> Dimensions of Bumper Mechanism

4-1-3. Motors and Encoders

TETRA-DS III™ locomotive system uses an advanced AC servo motors with high speed and torque. Each servo motor has highly precise optical encoder capable of Dead-Reckoning installed. Please contact our Customer Support Center if more detailed technical information on the components comprising the locomotive system such as the motors, encoders, and tires are required.

4-1-4. Casters

TETAA-DS III™ has a rear caster installed at the moving module. The caster with smooth 360 degree swivel motion helps to provide stable straight and turning movement to the platform. The wheel of the caster is made of plastic which will wear out after prolonged use. Contact the Customer Support Center to inquire about the replacement and to receive more detailed technical information if required.

Chapter 5. Electrical Hardware Specifications

Electrical specifications for each TETRA-DS III™ models are shown in the chart 5-1 below.
Each model comes with different battery and charger configuration and has different operating time and battery charge time. Depending on the operating environment, the actual operating time and the battery charge time may differ from the values listed in the chart 5-1.

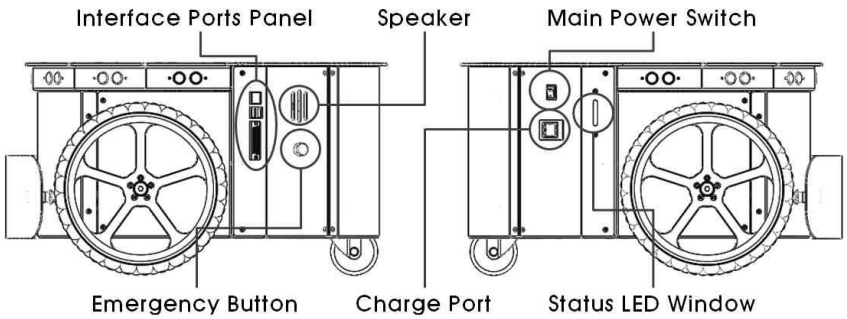
<Chart 5-1> Electrical Specifications of TETRA-DS III™

ITEMS		BASIC	ADVANCE	PRO
Power	Battery Type	24V 7A lead battery	24V 10A Ni-MH	24V 20A Li-PB
	Operating Time	3hrs	4hrs	8hrs
	Charge Time	3~4hrs	1.5~2hrs	1.5hrs

As shown in the chart 5-2 below, TETRA-DS III™ provides number of power and communications ports to connect the various sensors and devices. If required, additional ports can be added to the platform by installing the separate expansion board (Middle-Link Board). Please contact our Customer Support Center if you require more information on the Middle-Link Board or have questions concerning output ports.
<Chart 5-2> Available Power & Communication Ports

ITEMS		BASIC	ADVANCE	PRO
Power	5V	3 ports	3 ports	3 ports
	12V	2 ports	2 ports	2 ports
Communication	RS-232/485	N/A	1 port	1 port

Diagram 5-1 below shows the layout of TETRA-DS III™ electric components.



<Diagram 5-1> Electric Components Layout

5-1. Components

- Main Power Switch
- Emergency Button
- Status LED
- Interface Ports Panel
- Buzzer and Speaker
- Battery and Charger

5-1-1. Main Power Switch

The main power switch for turning on and off the platform power is located on the right top side of the TETRA-DS III™ as shown in the diagram 5-1. Once the power is switched on, LEds on the Status LED window light up and the buzzer sounds. For the BASIC model, platform becomes operational immediately after the power has been switched on. The ADVANCED and PRO models require the main control board to be

rebooted before the platform becomes operational. ADVANCED model uses the buzzer to notify the completion of the main control board reboot and the PAO model uses the speaker located on the left side of the platform to indicate the completion of reboot.

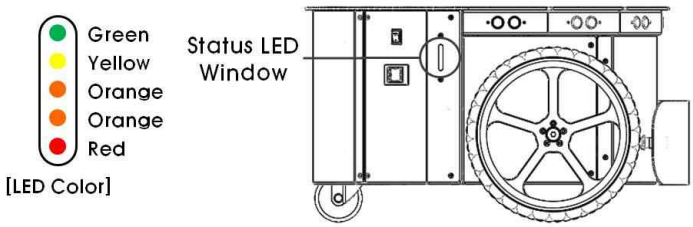
5-1-2. Emergency Button

The emergency stop button located on left side of the platform as shown in the diagram 5-1 is used in case of an error or to perform tests which require the drive motors to be stopped. When the emergency stop button is pushed, the red light on the emergency button comes on and the platform is forced to come to a stop. The drive motors that were forced to stop by the emergency button will not start regardless of the commands given. To disengage the emergency stop and operate the motors normally, push the emergency stop button one more time (the red light will go off to indicate emergency stop has been disengaged).

5-1-3. Status LED Window

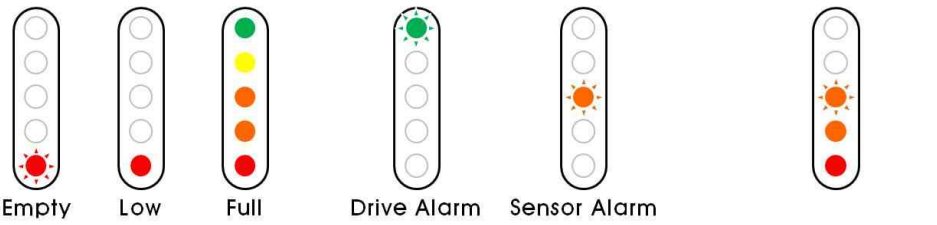
Status LED window is located on the left side of the platform as shown in the diagram 5-1. Comprised of 5 LEDs, the status LED window will automatically switch between Battery Level Mode, Diagnostic Mode, and Charge Mode depending on the status of the platform.

The Status LED window will show Battery Level when the platform is functioning normally, go in to Diagnostic Mode when platform shows a problem, and Charge Mode when the battery is being charged. When the circuit protector switch on the power board inside the DSCP is switched on to initialize the platform, all the LEDs in the status LED window will first light up and then go off for few seconds to calculate the battery level and come back on again and showing battery level.



<Diagram 5-2> Status LED Window

As shown in the diagram 5-3, Status LED window is capable of showing different information in three different modes depending on the status of the platform.



<Diagram 5-3> Status LED Window

Battery Level Mode

Status LED window shows the Battery Level Mode when the platform is operating normally. The LEDs will be lit according to the battery level as shown in diagram 5-3(a).

When the battery is full, all five LEDs will be lit as shown by the right picture in diagram 5-3(a). When the battery level is empty, all LEDs will be off except for the blinking bottom RED LED and the buzzer will sound to warn of empty battery level. When the battery level is less than full but more than empty, the LEDs will be lit according to the remaining battery level. Battery should be charged immediately using the included battery charger and cable when the LED shows empty battery level. Continuous use of the platform when the battery level is empty may completely drain the battery and lead to drastically reduced battery life and performance.

The battery will drain completely if the platform is stored for prolonged period of time without turning the power off first. Completely drained battery should be charged with the Force Charge button on the charger pressed. Forced charging is explained in detail in Battery & Charger section of this manual.

Diagnostic Mode

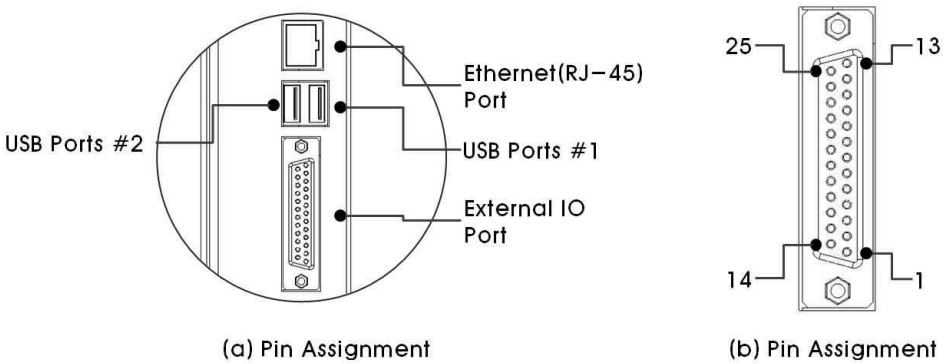
The Status LED window shows the Diagnostic Mode when there is a problem with the platform. Problem with either the drive board or the power sensor board in the DSCP with be shown in the status LED window as in the diagram 5-3(b). The green LED at the top will blink to show there is a problem with the drive board and if there is a problem with the power sensor board, orange LED in the middle will blink. Please contact the Customer Support Center with any questions concerning the error status.

Charge Mode

Charge mode shows the battery charge status as shown in the diagram 5-3(c). When the battery is being charged, the top most lit LED showing the battery level just prior to charging will start to blink while the bottom LEDs will remain lit as before. The diagram 5-3(c) illustrates the charge status when the battery level was about 50% when the platform battery started being charged. Check to make sure the charger is on and the cables are connected properly if the Status LED window does not change to Charge Mode after the battery charge cable has been plugged into the charge port of the platform. Contact the Customer Support Center if the Status LED window does not change to Charge mode even when the cables are properly connected and charger is on.

5-1-4. Interface Ports Panel

As illustrated in the diagram 5-1. Interface Port Panel for connecting the platform to the various sensors and devices are located on the left side of the TETRA-DS III™. Ports in the Interface Port Panel is comprised of Ethernet Port, USB Ports, and External IO Ports as shown in the diagram 5-4(a).



<Diagram 5-4> Components Layout of Interface Ports Panel and Pin Assignment of External IO Port

Ethernet Port

BASIC model cannot use the Ethernet Port as it does not include the VIA embedded Board in the DSCP. For the ADVANCED and PRO models, the Ethernet Port is used to connect and communicate with the desktop PC or the laptop computer. As explained in the Quick Start section of this manual, Ethernet Port is also used to connect with PMP (Platform Management Program) as well.

USB Port

BASIC model uses the #1 USB port to connect the boards in the DSCP such as the drive board and power/sensor board through the USB2Serial conversion device to the desktop PC or laptop computer. Also, as explained in the Quick Connect section of the manual, #1 USB port could be used to connect to the PMP (Platform Management Program) as well. #2 USB port cannot be used in the BASIC model as it does not have the VIA embedded Board installed in the DSCP. In ADVANCED and PRO models, USB

ports #1 and #2 are used to connect the platform to the devices that require USB connection such as the laser scanner.

External IO Port

External IO port is used to provide extra power to the various option devices such as the laser range finder, positioning sensor "GtarGazer", gyroscope sensor, and others. It also provides RS-485 communication port to control the Pan-Tilt module as well. BASIC model cannot use the RS-485 port as it does not have the VIA embedded Board installed in the DSCP. In order to communicate with the various optional devices mentioned above, user must purchase the equipment with compatible communications ports as the optional devices separately. Refer to the "Accessories and Optional Parts" section of the manual for details on available TETRA-DS III™ options. Custom made cables are required to use the External IO Port for purposes other than connecting to the optional parts. Please contact the Customer Service Center to enquire about custom cables. Chart 5-3 below shows the Pin Map Information for the External IO port.

<Chart 5-3> Pin Map Information of External IO Port

PIN No.	Description	Pin No.	Description
1	GND	14	NC
2	+5V (for LRF)	15	NC
3	+12V (for LRF)	16	GND
4	GND	17	NC
5	+5V (for StarGazer)	18	NC
6	+12V (for StarGazer)	19	GND
7	GND	20	NC
8	+5V (for Gyroscope)	21	NC
9	GND	22	GND
10	+7.4V (SMART MOTOR)	23	NC
11	GND	24	NC
12	RS-485 D+ (for SMART MOTOR)	25	GND
13	RS-485 D- (for SMART MOTOR)	-	

5-1-5. Buzzer and Speaker

All TETRA-DS III™ models come equipped with a buzzer to warn of low battery level or problem with the platform. The PRO model comes equipped with an additional speaker on the left side of the platform. Check the platform carefully if buzzer sounds during the operation and contact the Customer Service Center if the buzzer continues to sound even when the cause could not be found.

5-1-4. Battery and Charger

Each model of the TETRA-DS III™ is equipped with different battery and charger configuration. Chart 5-4 shows the detailed battery and charger information for each platform model. The BASIC model has 24V, 7A standard Lead-acid battery installed and the charger is model FHC-2407 manufactured by FairStone Company. If the battery or the charger needs to be replaced, contact our Customer Support Center or the manufacturer. The ADVANCED and PRO modes are equipped with our custom developed battery charger to quick charge the installed NiMH and Li-PB batteries and our OEM manufactured replacement batteries. The PRO model comes with highly efficient, high capacity, and long life Lithium-ion Polymer Battery.

The installed battery will eventually die (no longer able to hold charge) after long period of use in the platform. Do Not disassemble the dead battery without first contacting our Customer Support Center for instructions. The user is entirely responsible for any damages or injuries that may arise from modifying or disassembling the battery. It is important to contact our Customer Support Center for information or instructions before replacing or disassembling the battery. Please contact the Customer Support Center to receive more detailed technical information.

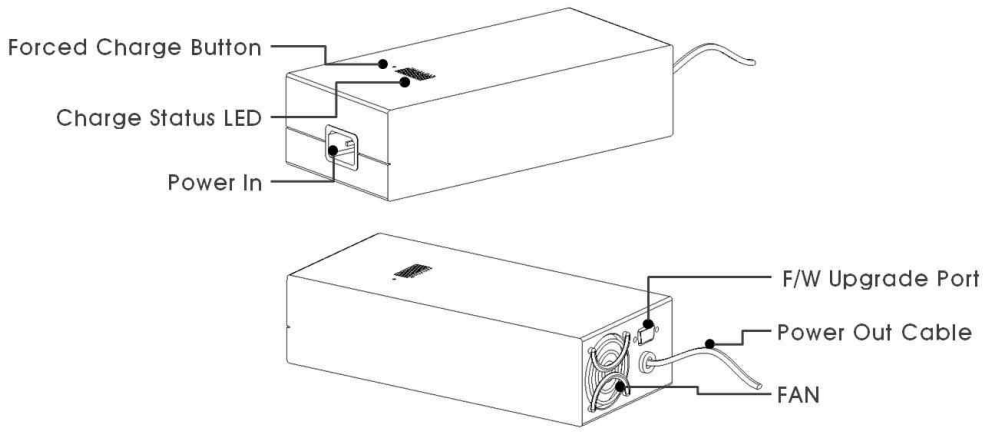
<Chart 5-4> Specifications of Battery and Charger

SECTION	ITEMS	BASIC	ADVANCE	PRO
Battery	Type	Lead-acid	Ni-MH	Li-PB
	Nominal Voltage	24V	24V	24V
	Capacity	7Ah	10Ah	20Ah
Charger	Input Voltage	AC 110~220V	AC85~245V	AC100~220V
	Output Voltage	27~29.4V	24~29V	24~29V
	Charge Method	CC/CV	CC/CV	CC/CV
	Power	180W	100W	450W

The Li-Po battery installed in the PRO model is highly efficient and has longer life span than other type of batteries, but care must be taken so that the battery does not become completely discharged as it will decrease the battery life span and the capacity to hold charge. To prevent complete discharge, make sure to switch off the platform power before storing for long period of time. Refer to the charger section below for information on charging completely discharged battery.

Charger – ADVANCED Model

The TETRA-DS III™ ADVANCED model includes quick charge battery charger and the AC 220V input cable and the output cable for the charging the platform battery. Refer to the diagram 5-5 to see the charger layout.



<Diagram 5-5> Charger Components Layout (ADVANCED Model)

Power In

Connection for 220V AC Power cord

Charge Status LED

Shows the status of the charger. The LED lights up when the charging.

F/W Upgrade Port

Charger firmware upgrade port. Not for use by the consumer.

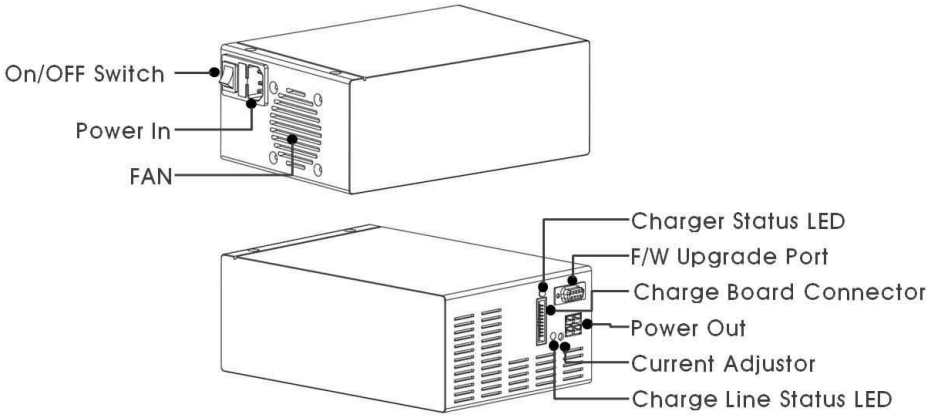
Charge Out Cable

Connects to the battery charge port located at side of the platform.

If the battery in the ADVANCED model has been completely discharged, press and hold the force charge button shown in the diagram 5-5 to charge the battery. Make sure to use only the provided charger to charge the battery installed in the platform. Using another charger may result in damaging the platform and voiding the warranty.

Charger – PRO Model

The TETAA-DS III™ PAO model includes quick charge battery charger, force charge board, AC 220V input cable, and the output cable for the charging the platform battery. Refer to the diagram 5-6 to see the charger layout.



<Diagram 5-6> Charger Components Layout (PAO Model)

On/Off Switch

Power on/off switch. Turn the power on only when charging.

Power In

Connection to 220V AC power cord.

Charge Status LED

Shows the charger status. LED lights when the charger power is on.

F/W Upgrade Port

Firmware upgrade port, Not for use by the consumer.

Charge Board Connector

Used for connecting to the included forced charge board. Connect the charger to the forced charge board to force charge the battery. Refer to the diagram 5-9 for force charge steps.

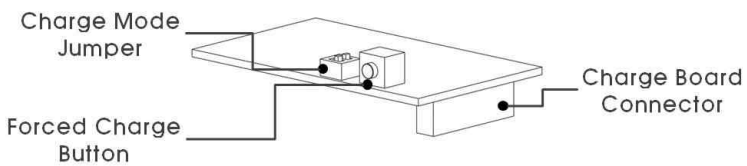
Current Adjustor

Current adjustor is used to adjust the output current of the charger.
Default value should be used to charge the platform battery. Changing the output current may damage the platform and void the warranty.

Charge Line Status LED

Shows the connection status between the charger and the platform battery.

The PAO model includes forced charge board to charge completely discharged platform battery. The forced charge board layout is shown in the diagram 5-7. Contact the Customer Support Center if the forced charge board becomes lost or damaged.



<Diagram 5-7> Charge Board Components Layout (PAO Model)

Charge Mode Jumper

Used to change the charge mode of the charger. Use only the default setting as other settings may damage the platform and void the warranty.

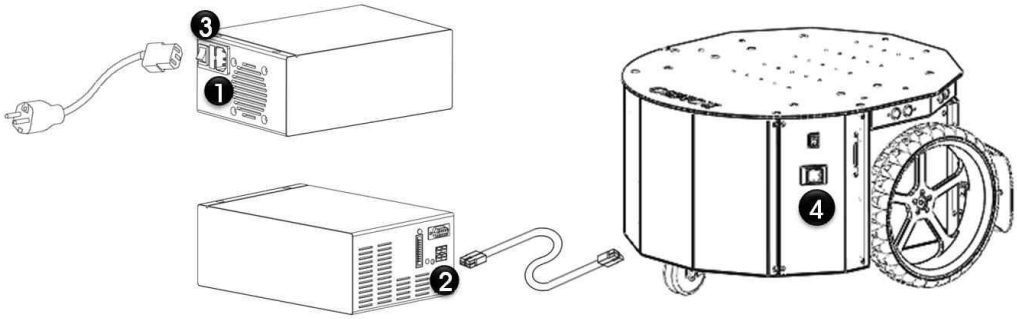
Forced Charge Button

Used for force charging the battery. The Forced Charge Button should only be used when force charging is required. Use of forced charge button when force charging is not required may damage the platform and void the warranty.

Charge Board Connector

Connects the forced charge board to the charger.

Follow the steps in the diagram 5-8 to charge the battery under the normal condition.



<Diagram 5-8> Normal Charge Procedures (PAO Model)

Step 1.

Connect the 220V AC cable to the charger and the plug other end into the 220V wall socket.

Step 2.

Connect the charger cable to the charger.

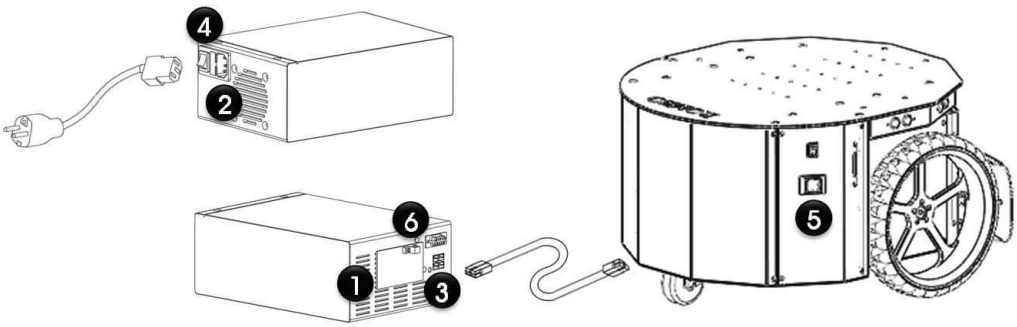
Step 3.

Switch on the charger power.

Step 4.

Connect the charger cable to the platform.

When the battery installed in the platform has been completely discharged, it cannot be charged using normal charging method. To charge completely discharged battery, press and hold the forced charge button on the forced charge board and connect the charge cable to the platform to force charge the battery. Follow the steps in the diagram 5-9 to force charge the battery. Contact Customer Support Center if force charge still does not charge the battery.



<Diagram 5-9> Forced Charge Procedures (PAO Model)

Step 1.

Connect the forced charge board and the charger.

Step 2.

Connect the 220V AC cable to the charger and the plug other end into the 220V wall socket.

Step 3.

Connect the charge cable to the charger.

Step 4.

Turn the charger power on.

Step 5.

Connect the charger cable to the platform.

Step 6.

Push the forced charge button on the force charge board.

Only use the provided charger to charge the installed battery in the platform. Use of any other charger to charge the battery may damage the platform and void the warranty.

Chapter 6. Sensor System Specifications

As shown in the chart 6-1 below, TETRA-DS III™ is available in three different models with different sensor configurations to meet the needs of users. Refer to the "What is TETRA-DS II" section of the manual for more information on sensors attached to each model.

<Chart 6-1> Sensory System Specifications of TETRA-DS III™

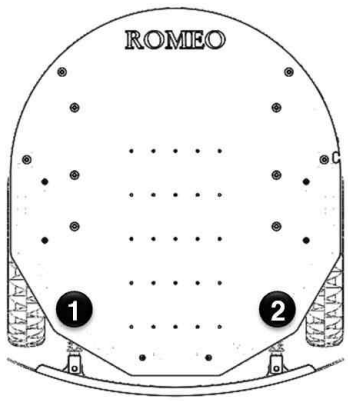
ITEMS		BASIC	ADVANCE	PRO
Sensor System	Bumper Sensor	Option	3 direction sensor, 180deg forward sensing	
	Ultrasonic Sensor	7units, Ring Array		

6-1. Components

- Bumper Sensors
- Ultrasonic Sensors

6-1-1. Bumper Sensors

TETRA-DS III™ ADVANCED and PRO models come with the bumper mechanism installed as standard equipment. When sensors in the bumper detect a collision, it is able to determine the location of the obstacle by dividing the collision position into three distinct areas. The BASIC model does not include the bumper mechanism as standard equipment but it could be purchased and added if required. The bumper mechanism has two micro switches that act as sensors and they are positioned as shown in the diagram 6-1. When collision occurs with an obstacle, the position of the collision area is determined by the combination of signals from two micro switches. Refer to the micro switch positions in the diagram 6-1 when using DSSP-HAL to process information from the bumper sensors. Refer to the DSSP-HAL manual for detailed information on DSSP-HAL service.

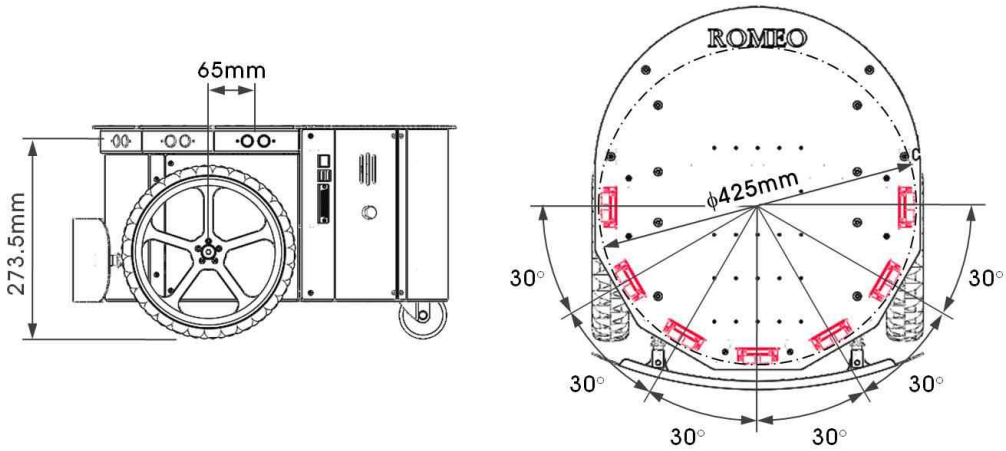


<Diagram 6-1> Bumper Sensors Configuration

Refer to the "Mechanical Hardware Specifications" section of the manual for more technical information on the bumper mechanism. Contact Customer Support Center to receive more information on the micro switches or to inquire about custom made bumper mechanism.

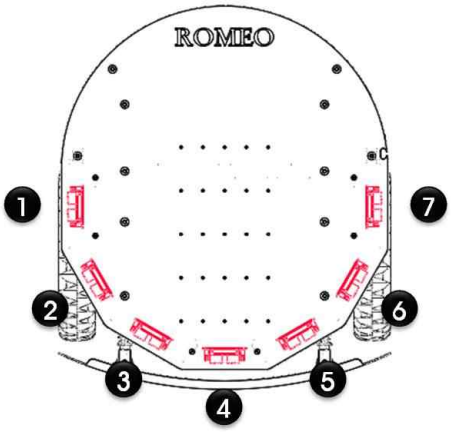
6-1-2. Ultrasonic Sensors

All TETRA-DS III™ models include set of ultrasonic sensors installed in half circle pattern as in diagram 6-2 to detect nearby obstacles. To show nearby obstacles in map format, use the sensor installation measurements in the diagram 6-2 as a reference.



<Diagram 6-2> Dimensions of Ultrasonic Sensors

There are total of 7 ultrasonic sensors installed on the platform in half circle pattern. Diagram 6-3 shows the position of each sensor on the platform. Refer to the section 7-2-4 of the manual for information on connecting each ultrasonic sensor. Refer to the ultrasonic sensor positions in the diagrams6-2 and 6-3 when using DSSP-HAL to process information from the ultrasonic sensors. Refer to the DSSP-HAL manual for detailed information on DSSP-HAL service.



<Diagram 6-3> Ultrasonic Sensors Position

Contact Customer Support Center to purchase and install additional ultrasonic sensors. Additional technical information is available from the customer support center or from the manufacturers website.

Chapter 7 Control Hardware Specifications

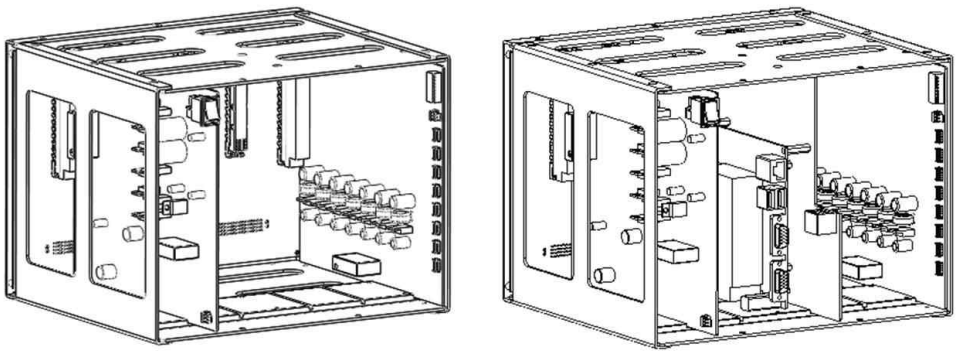
All TETAA-DS III™ models have our modular DSCP (DaSarobot Control Hardware Platform) installed. Form factor and modular design of the control boards allow the boards to fit into the slots in the DSCP allowing easy maintenance and expansion capability. Damaged board can be easily taken out for repair or replacement. Contact our Customer Support Center for board repairs or to purchase new or additional boards.

<Chart 7-1> Control Hardware Specifications of TETAA-DS III™

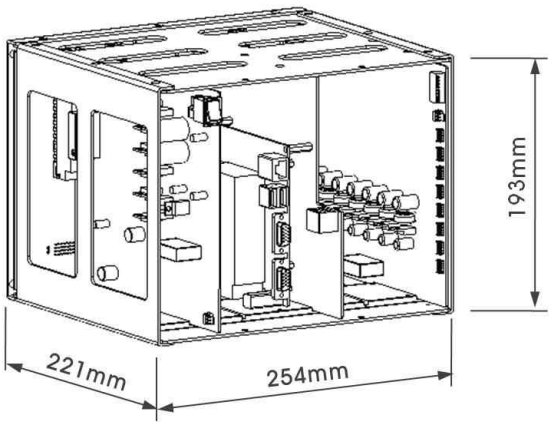
ITEMS		BASIC	ADVANCE	PRO
DSCP	Main Control Board	N/A	VIA Embedded B/D	
	Power/Sensor Board	Installed		
	Drive Board	Installed		
Others	Sensor-Link Board	Installed		
	Middle-Link Board	Option		
	USB2Serial Device	Installed	Option	

7-1. DSCP Components

The modular hardware platform DSCP image is shown in the diagram 7-1. The DSCP has metallic container type external casing and supports and protects the control boards that fit in the internal slots. Diagram 7-1 (a) shows the BASIC model DSCP and the diagram 7-1 (b) shows the ADVANCED and PRO model DSCP. External dimensions are shown in the diagram 7-2.

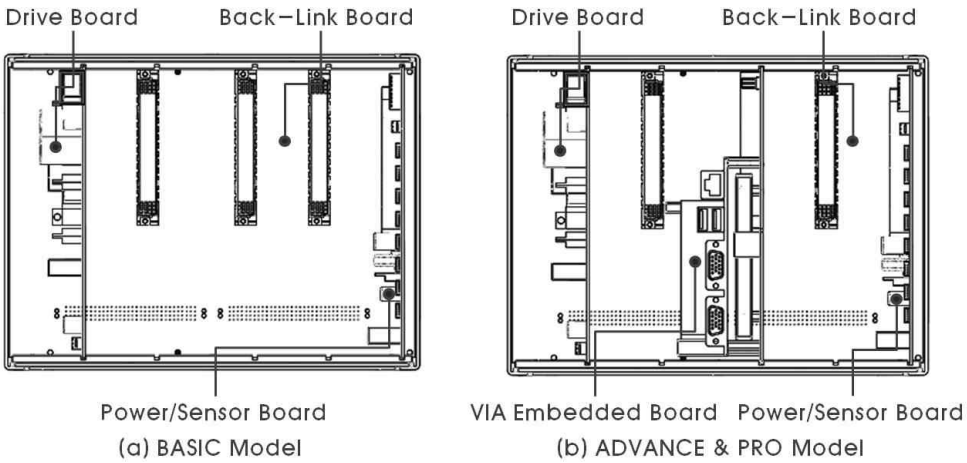


<Diagram 7-1> Images of DSCP



<Diagram 7-2> Dimensions of DSCP

The DSCP in BASIC model is comprised of Power/Sensor board, Drive board, and Back-Link Board as shown in diagram 7-3 (a) below. Diagram 7-3(b) shows the ADVANCED and PRO model DSCP which is comprised of VIA Embedded Board, Power/Sensor Board, Drive Board, and Back-Link Board.



<Diagram 7-3> DSCP Boards Layout

The VIA Embedded Board controls and communicates with the Power/Sensor board and the drive board as well as communicating with the desktop PC or laptop computer. Power/Sensor board manages and controls the platform power and transmits information from various attached sensors. Drive board controls the AC servo motors attached to the platform. The above boards are all connected to the Back-Link board which facilitates communication between the boards.

TETRA-DS III™ BASIC model does not have VIA Embedded Board installed. BASIC unit instead uses Multil-2/USB signal conversion device manufactured by SystemBase to communicate between the PC or laptop computer and the Power/Sensor Board and the Drive Board.
Multi-2/USB coverts USB signal to serial signal and it is connected to the USB port in the interface panel on the left side of the platform. To connect the Platform to the PC or laptop, use the USB port on the left side of the platform. Refer to the manufacturers' website if more information is required for the Multi-2/USB.
To provide more versatility to the ETRA-DS III™, boards such as the Middle-Link Board to support additional power and communications ports or SBC (Single Board Computer) module to process video information from the vides sensors, process complex equations, and perform autonomous movement is available as an option. Contact the Customer Support Center to inquire about purchasing the optional boards.

7-2. Components

- VIA Embedded Board
- Power/Sensor Board
- Drive Board
- Back-Link Board
- Sensor-Link Board

7-2-1. VIA Embedded Board

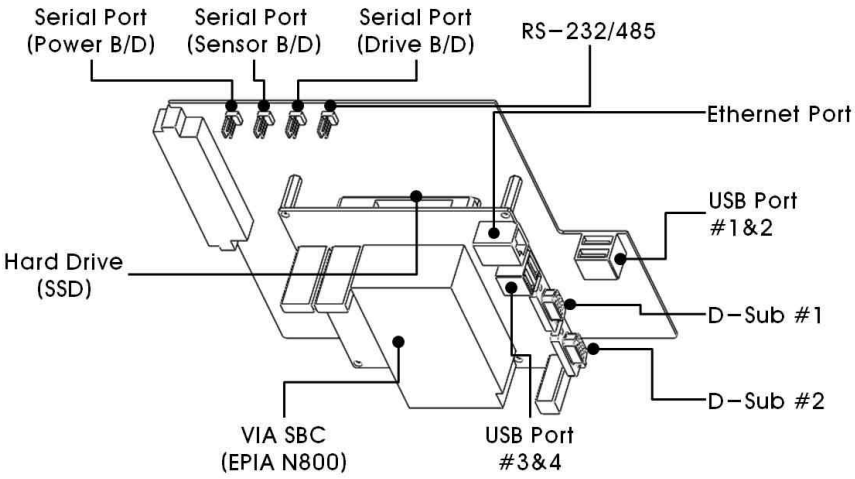
Main control board operates on Linux OS and runs unified communications service DSSP-HAL to control various devices installed in the platform. Refer to the chart 7-1 below for board specifications.

<Chart 7-1> Specifications of the VIA Embedded Board

ITEMS	SPECIFICATIONS
SBC	VIA EPIA-N700 or N800

HDD	32G SSD
Serial	RS-232 — 3 Ports, RS-232/485-1 Port
OS	Ubuntu

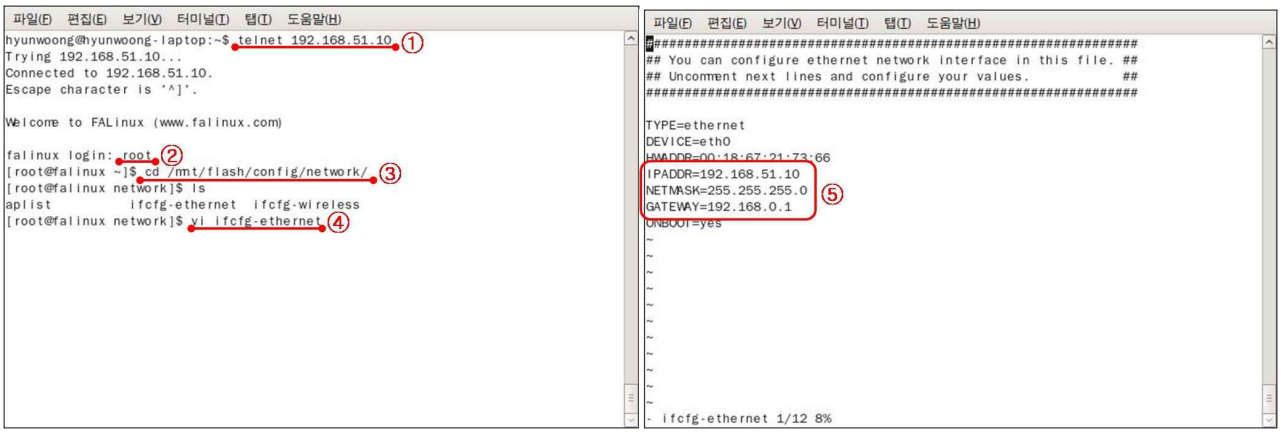
The diagram 7-4 below shows the components comprising the VIA Embedded Board.

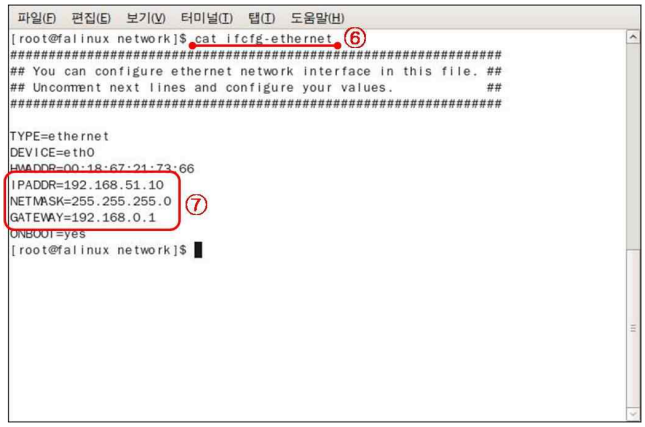


<Diagram 7-4> Components Layout of VIA Embedded Board

Refer to the VIA website for technical details on VIA SBC.

The IP address of the VIA Embedded Board is initially set at 192.168.51.10. for the DSSP-HAL service. Refer to the diagram 7-5 below to change the IP address.





〈Diagram 7-5〉 IP Address Change Procedures

Step 1.

Use Telnet to contact VIA Embedded Board.

telnet 192.168.51.10

Step 2.

Login at root level. Password is not required at login.

root

Step 3.

Change the directory to /mnt/flash/config/network/

cd /mnt/flash/config/network/

Step 4.

Use vi editor to open the 'ifcfg-ethernet' file in the folder /mnt/flash/config/network/ '

vi ifcfg-ethernet

Step 5.

Use the vi editor to charge the IP address, NETMASK, GATEWAY to desired value.

Step 6.

Use cat command to open modified ifcfg-ethernet file.

cat ifcfg-ethernet

Step 7.

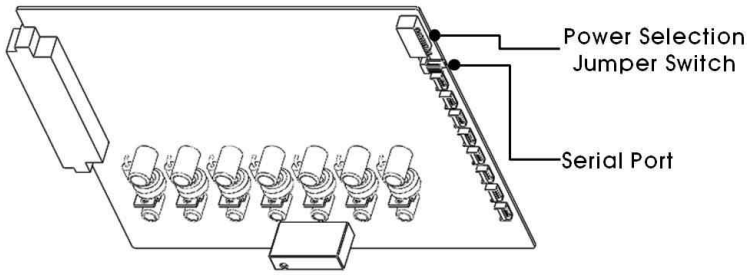
Check the saved tcp/ip value and use the reset switch to reboot the VIA Embedded Board.

Warning! VIA Embedded Board may not boot properly if the ifcfg-ethernet file is not saved properly. Make sure to check the tcp/ip value before rebooting.

Contact the Customer Support Center for more detailed technical information concerning the VIA Embedded Board.

7-2-2. Power/Sensor Board

Power/Sensor Board supplies power to the various devices installed on the platform, turns drive board power on or off, monitors and manages power usage. The board also collects and transmits information from the installed sensors such as the ultrasonic sensors and bumper sensors. The diagram 7-6 shows the image of the Power/Sensor Board.



<Diagram 7-6> Image of Power/Sensor Board

Contact the Customer Support Center to receive more information concerning the jumper switch and the serial port shown in the diagram 7-6.

Power Selection Jumper Switch

Jumper switch is used to power on/off the various devices installed in the platform. If the switch is ON, VIA embedded board is able to turn on/off the power to the related device. If the jumper switch is OFF, power to the related device is cut off and the VIA Embedded Board has no ability to turn on/off the power to the device,

Chart 7-2 shows the device related to each switch.

<Chart 7-2> Peripheral Devices Power ON/OFF Selection Switches

S/W No.	Related Device	Comment
S/W 1	Laser Scanner Sensor	
S/W 2	Stargazer Sensor	
S/W 3	SBC MOdule	When Middle-Link board used
S/W 4	Servo Motor (Robotis Dynamixel)	When Middle-Link board used
S/W 5	Gyroscope Sensor	When Middle-Link board used
S/W 6	LCD Module	When Middle-Link board used
S/W 7	Reserved	
S/W 8	Reserved	

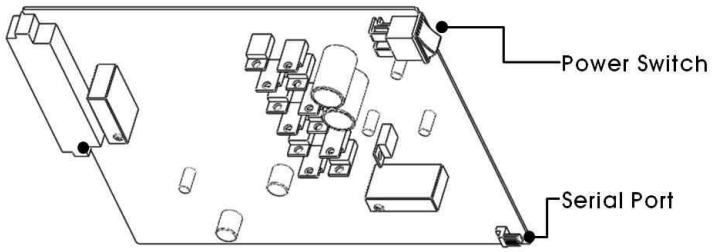
RS-232C Port

Serial port for communicating with the VIA Embedded board. Communication occurs as RS-232C and the baud rate is set at 115,200bps. Baud rate should not be changed arbitrarily. Consult the Customer Support Center if baud rate needs to be changed for some reason.

Variety of functions offered by the Power/Sensor Board is provided by the "Power Service" and the "Sensor Service" part of the DSSP-HAL service. Refer to the separate DSSP-HAL manual for detailed information.

7-2-3. Drive Board

The Drive Board controls the high performance AC servo motors attached to the platform and also coordinates input from the bumper sensors and the emergency stop button to work together with the servo motors to provide increased level of safety to the platform motion. Refer to the Bumper Sensor and the Emergency Stop Button section of the manual for more detailed information. The board also estimates platform position through Dead-Reckoning. Refer to the diagram 7-7 below to view the layout of the Drive Board.



<Diagram 7-7> Components Layout of Drive Board

Power Switch

The power In/Out switch is initially set to "In" position. When the switch is at "In" position, VIA Embedded Board is able to turn the power on/off to the Drive Board. When the switch is set to "Out" position, the power to the drive board is disconnected and the VIA Embedded Board is not able to turn the power on/off to the Drive Board. When the platform is being controlled through the VIA Embedded Board and the servo motors are not operating, check the switch setting to see if it's at "Out" position.

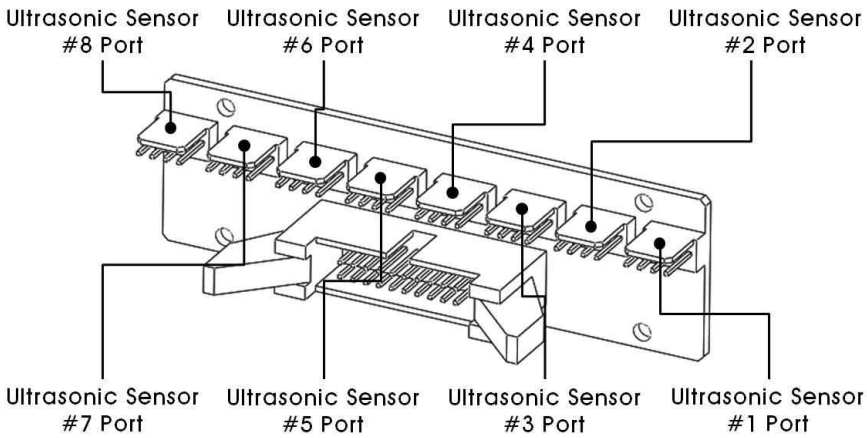
RS-232C Port

RS-232C port is serial port for communicating with the VIA Embedded board. Communication occurs as RS-232C and the baud rate is set at 115,200bps. Baud rate should not be changed arbitrarily. Consult the Customer Support Center if baud rate needs to be changed for some reason.

Variety of functions offered by the Drive Board is provided by the "Drive Service" part of the DSSP-HAL service. Refer to the separate DSSP-HAL manual for detailed information.

7-2-6. Sensor-Link Board

Sensor-Link Board is an intermediate link board between the ultrasonic sensors and the Power/Sensor board installed in the DSCP. The diagram 7-10 below shows the layout of the Sensor-Link Board.



<Diagram 7-8> Components Layout of Sensor-Link Board

Ultrasonic Sensor Ports

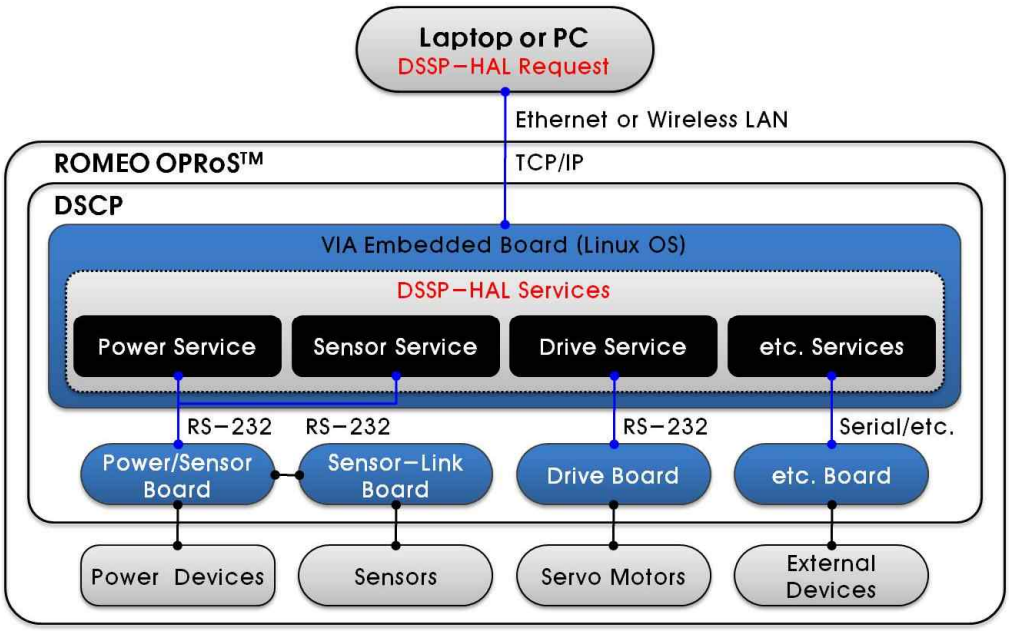
Seven ultrasonic sensors installed on the platform as standard equipment connects to the ultrasonic sensor ports. Care must be taken to connect each sensor with correct port #. Refer to the section 6-1-2 of the manual for sensor position.

Contact Customer Support Center if more technical information is required.

Chapter 8. Control Scheme

8-1. Control Schematic Diagram

TETRA-DS III™ is controlled by the DSSP-HAL service through unified TCP/IP communications protocol. The chart 8-1 below shows the platform control schematic.

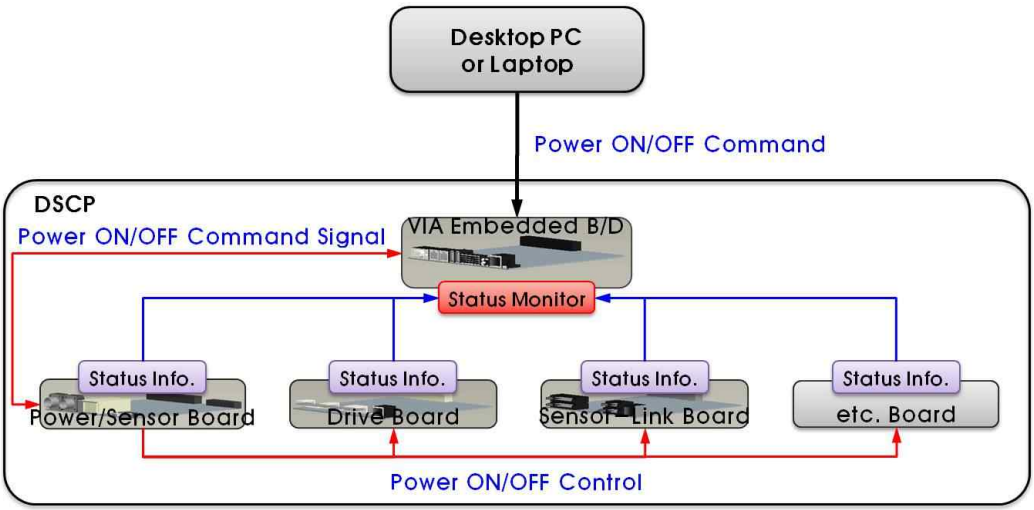


<Chart 8-1> Control Schematic Diagram

As shown in the chart 8-1, platform communicates with the desktop PC or laptop computer through the Ethernet cable or wireless LAN using only TCP/IP protocol. When DSSP-HAL Request command is sent from the PC or the laptop, command is sent through the DSSP-HAL service in the VIA Embedded Board installed in the DSCP to the relevant lower level board. The lower level board connects to the device and performs the commanded task. Various boards and devices comprising the DSCP communicates with the VIA Embedded Board through serial or other supported communications protocol. To use "other" devices, contact our Customer Support Center to receive DSSP-HSAL service support.

8-2. Power Control Schematic Diagram

To accommodate the need to turn on/off the power to the control boards individually under certain cases, DSPC has been designed with the capability to control the individual board power through the DSSP-HAL service. As shown in the chart 8-2 below, the command to turn on/off the power to the specific control board is sent from the PC or laptop through the DSSP-HSAL service to VIA Embedded Board in the DSCP. The command is then sent from the VIA Embedded board to the Power/Sensor Board which in turn controls the power to the connected boards (Drive board, Sensor Link Board, Other Board).



<Chart 8-2> Power Control Schematic Diagram (ADVANCED & PRO Model)

Refer to the separate "DSSP-HAL" manual for more information concerning the DSSP-HAL service.

Chapter 9. Accessories & Optional Parts

TETRA-DS III™ supports variety of sensors required for developing autonomous navigational S/W. Most of the more popular or common option parts are kept in our inventory and available immediately after ordering. These popular option parts are supported by our software platform "DSSP-HAL" service which is very useful when developing of autonomous navigational software. Refer to separate "DSSP-HAL" manual for details concerning the "DSSP-HAL" service.
Please contact our Customer Support Center to enquire about mounting sensors and devices other than those provided by us as option part.

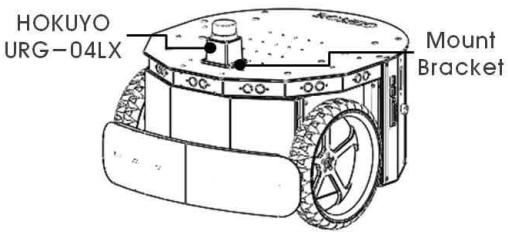
Standard available option parts for TETRA-DS III™ are as follows:

9-1. Laser Rangefinder

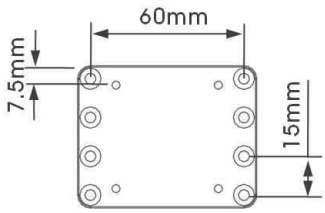
The mounting brackets are available as option part for the Laser Rangefinders which are capable of measuring the distance to the obstacles around the platform. The TETRA-DS III™ supports wide range of Laser Rangefinder models from the two manufacturing companies HOKUYO and SICK. Please contact our Customer Support Center if you wish to install the Laser Rangefinder from another manufacturer.

9-1-1. HOKUYO URG-04LX

The diagram 9-1 below shows the mounting bracket and the HOKUYO Laser Scanner URG-04LX installed on the TETRA-DS III™. As shown in the diagram 9-1(b), mounting bracket has multiple evenly spaced mounting holes to mount the URG-04LX in various locations on top of the mount plate. Please contact our Customer Support Center to mount the device on nonstandard location.



(a) Figure

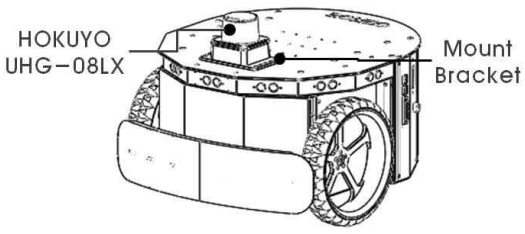


(b) Dimension of Bracket

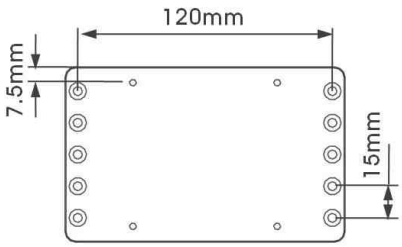
<Diagram 9-1> Option Part – HOKUYO URG-04LX

9-1-2. HOKUYO UHG-08LX

The diagram 9-2 below shows the mounting bracket and the HOKUYO Laser Scanner URG-08LX installed on the TETRA-DS III™. As shown in the diagram 9-2(b), mounting bracket has multiple evenly spaced mounting holes to mount the UGH-08LX in various locations on top of the mount plate.



(a) Figure



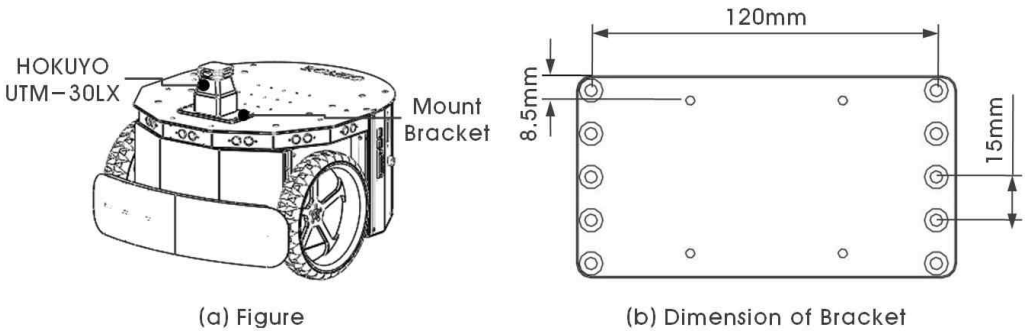
(b) Dimension of Bracket

<Diagram 9-2> Option Part – HOKUYO UHG-08LX

9-1-3. HOKUYO UTM-30LX

The diagram 9-3 below shows the mounting bracket and the HOKUYO Laser Scanner UTM-30LX installed on the TETRA-DS III™. As shown in the

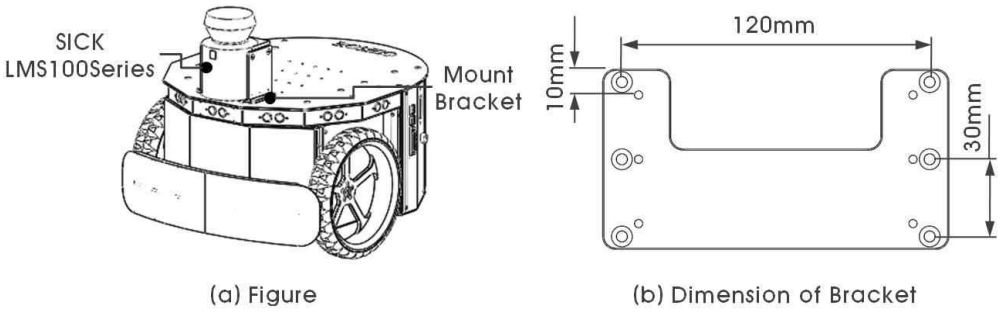
diagram 9-3(b), mounting bracket has multiple evenly spaced mounting holes to mount the UTM-30LX in various locations on top of the mount plate.



<Diagram 9-3> Option Part – HOKUYO UTM-30LX

9-1-4. SICK LMS100 Series

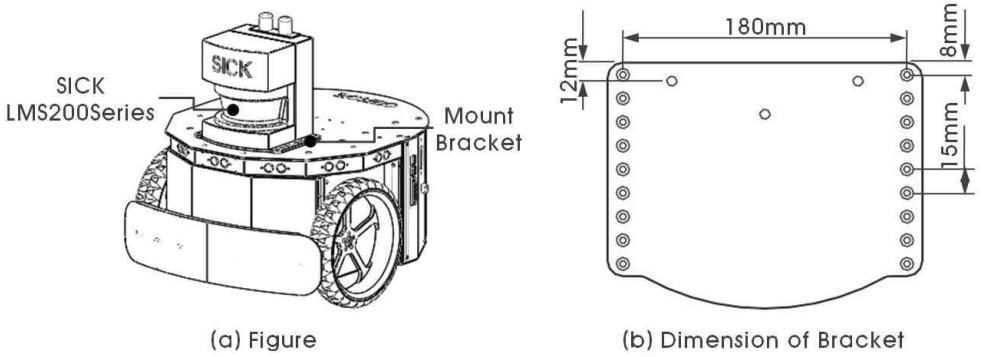
.The diagram 9-4 below shows the mounting bracket and the SICK Laser Scanner LMS100Series installed on the TETRA-DS III™. As shown in the diagram 9-4(b), mounting bracket has multiple evenly spaced mounting holes to mount the LMS100Series in various locations on top of the mount plate.



<Diagram 9-4> Option Part – SICK LMS100Series

9-1-5. SICK LMS200 Series

.The diagram 9-5 below shows the mounting bracket and the SICK Laser Scanner LMS200Series installed on the TETRA-DS III™. As shown in the diagram 9-5(b), mounting bracket has multiple evenly spaced mounting holes to mount the LMS200Series in various locations on top of the mount plate.



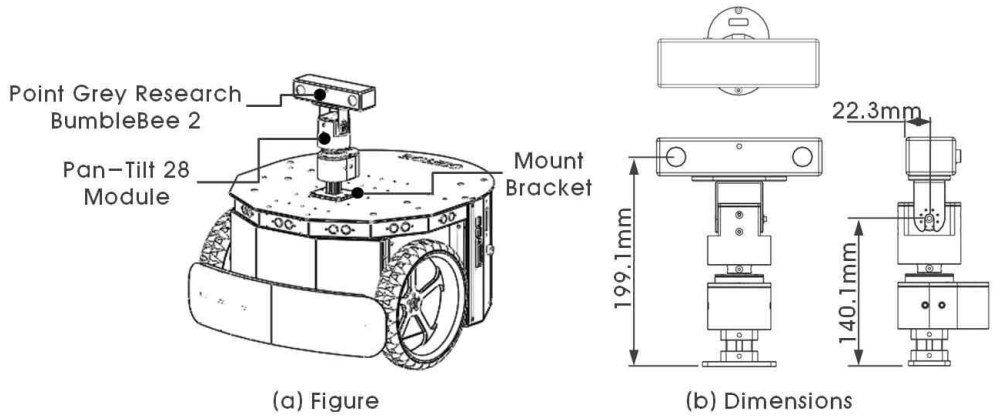
<Diagram 9-5> Option Part – SICK LMS200Series

9-2. Camera

The mounting brackets are available as option part for the "Camera" required for developing video processing S/W. TETRA-DS III™ supports stereo camera Bumblebee2 manufactured by Point Grey Research Inc. Please contact our Customer Support Center if you wish to install a camera from another manufacturer.

9-1-5. Bumblebee2 w/ Pan-Tilt Mechanism

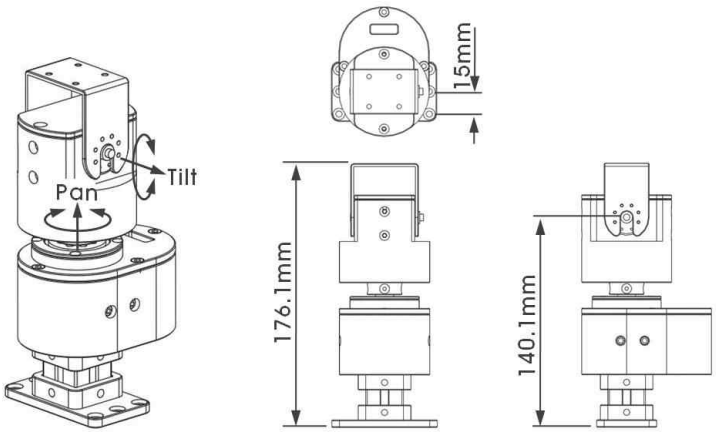
The diagram 9-6(a) below shows the platform with stereo camera Bumblee2 and the pan-tilt module installed. Diagram 9-6(b) shows the dimensions of the installed camera and the module. Please contact our Customer Support Center if you wish to install the camera without the pan-tilt module.



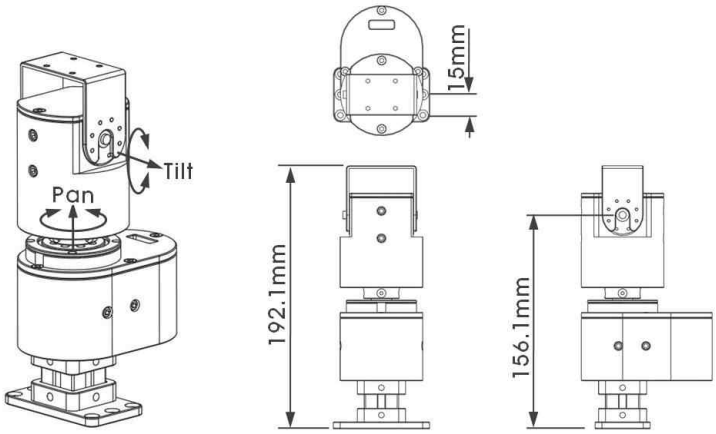
<Diagram 9-6> Option Part – Bumblebee 2 w/ Pan-Tilt 28 Module

9-3. Pan-Tilt Module

As shown in diagram 9-7 and 9-8, there are two different models of high speed pan-tilt modules with advanced servo motors available as options part. Similar to other brackets, the mounting brackets for the pan-tilt modules have multiple evenly spaced mounting holes to mount the modules in various locations on top of the mount plate. Weight of the camera or sensor device should be taken into consideration when deciding to purchase the pan-tilt module. Please contact our Customer Support Center if you wish to have pan-tilt module custom made to suit your need.



<Diagram 9-7> Option Part – Pan-Tilt 28 Module



<Diagram 9-8> Option Part — Pan-Tilt 64 Module

Chart 9-1 below shows the specifications of the two available pan-tilt models.
Please contact our Customer Support Center if more detailed technical information is required.

<Chart 9-1> Specifications of Pan-Tilt Modules

SECTION	ITEMS	SPECIFICATIONS	
		PAN-TILT 28 MODULE	PAN-TILT 64 MODULE
Physical	Dimension	L86.6×W60×H176.1mm	L95.1×W60×H192.1mm
	Weight	about 660g	about 785g
Servo Motor*	Input Voltage	DC 12~16V	DC 12~16V
	Torque	2.77~3.70N.m	2.77~3.70N.m
	Resolution	0.29degree	0.29degree
	Communication	RS-485	RS-485
Pan Motion	Angle Range	±150degree (0°- Front)	±150degree (0°- Front)
	Angular Velocity	476~360degree/sec	476~360degree/sec
Tilt Motion	Angle Range	±90degree (0°- Horizontal)	±90degree (0°- Horizontal)
	Angular Velocity	476~360degree/sec	476~360degree/sec

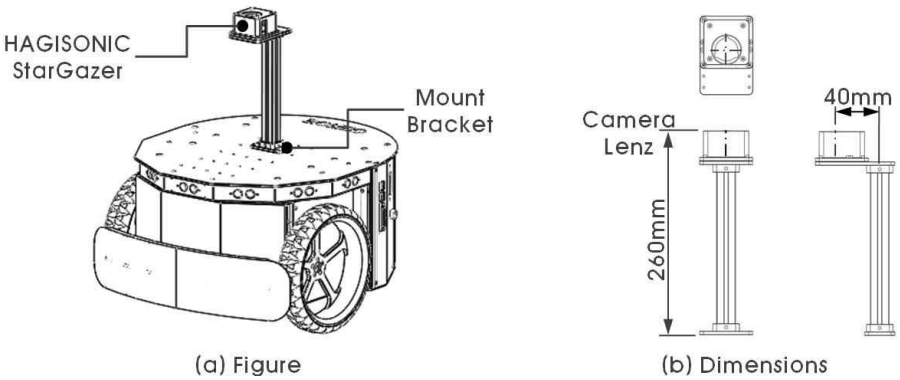
* Servo Motor : Robotis Dynamixel AX-28, AX-64

9-4. Localization Sensor

Mounting bracket is available as option part for the Localization Sensor used for developing autonomous movement S/W. TETAA-DS III™ supports localization sensor model "GatarGazer" manufactured by HAGISONIC. Please contact our Customer Support Center if you wish to install the localization sensor from another manufacturer.

9-4-1. HAGISONIC StarGazer™

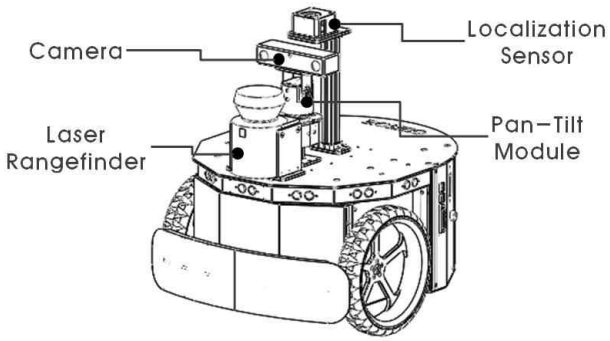
The diagram 9-9(a) below shows the platform with HAGISONIC "StarGazer" installed. Diagram 9-9(b) shows the dimensions of the installed "StarGazer". The mounting brackets for the "StarGazer" have multiple evenly spaced mounting holes to mount the device in various locations on top of the mount plate. Customer wishing to change the height and the location of the mounting bracket must indicate the change at the time of order.



<Diagram 9-9> Option Part – HAGISONIC StarGazer™

9-5. Combination of Option Parts

Various option parts available for TETRA-DS III™ can be combined and mounted on the platform according to the needs of the user as as shown in diagram 9-10 below. Please contact our Customer Support Center if custom made brackets are required to mount nonstandard combination of sensors and devices.



<Diagram 9-10> Combination of Option Parts

9-6. Single Board Computer Module

SBC (Single Board Computer) is available as option part for the TETRA-DS III™. Users wishing to replace the desktop PC or laptop computer with SBC should contact our Customer Support Center for more information. When using SBC, Middle-Link board may be added to the DSCP in the platform. Refer to the "DSCP" section in Chapter 7 for details concerning the Middle-Link Board.

9-7. Wireless Local Area Network Card

USB type "wireless LAN module" that connects to the VIA Embedded Board in the DSCP is available as option part for TETRA-DS III™. Please contact our Customer Support Center with any enquires concerning the use of "wireless LAN module" to control the platform.