

User Guide

PIC16F1947 Remote Access Protocol for Robot Control

Remote Robot Control Program (RRCP)

March 20, 2014

IONOTRONICS Corporation

<http://www.ionotronics.com>

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1 Introduction

This User Guide documents the commands available for the Remote Robot Control Program (RRCP) using the PIC16F1947. Typically, the PIC16F1947 adaptor board is attached to the Eoraptor platform. The Eoraptor also supports a WiFi adaptor attachment. Commands can be sent via an RS-232 connection to the Eoraptor or through WiFi RS-232 support.

See the User Guide for the MK-28988 PIC16F1947Adaptor for details.

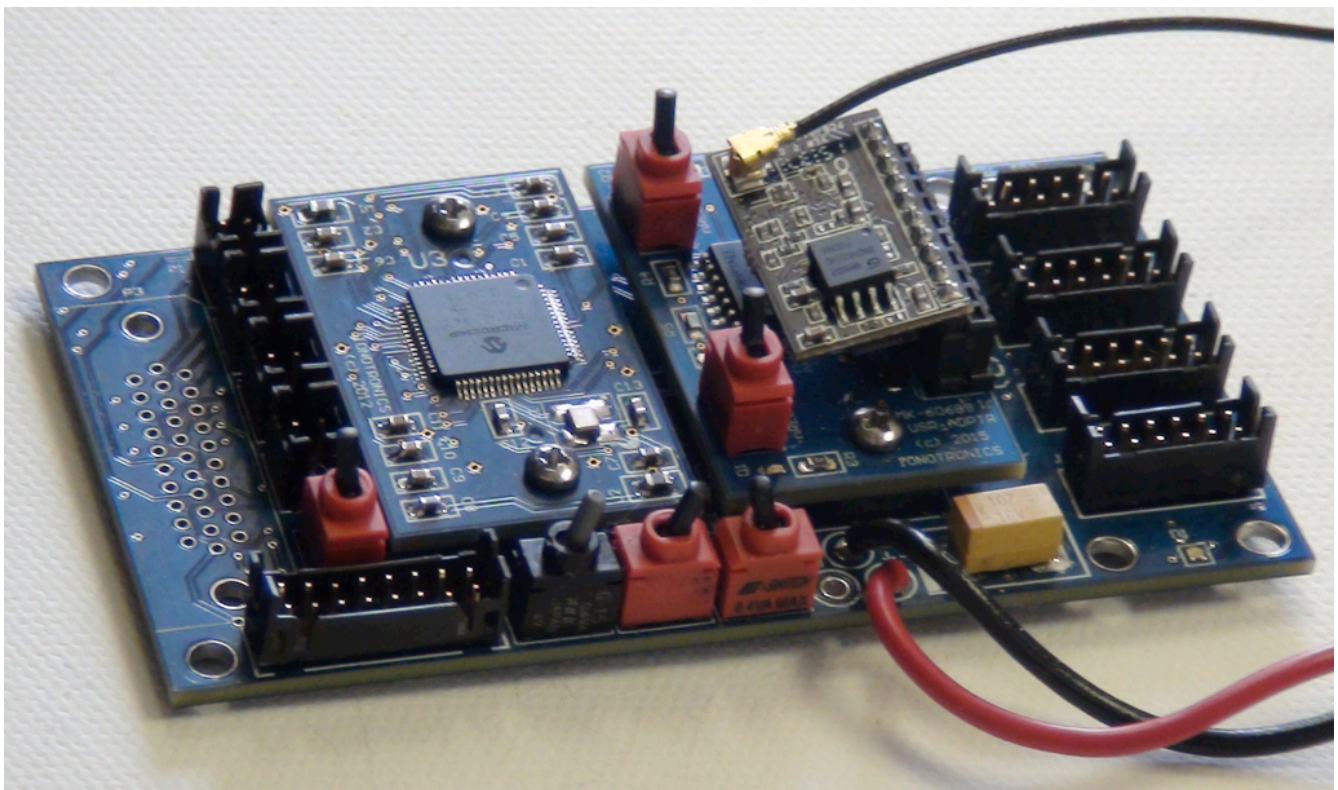


Figure 1 PIC16F1947 Adaptor and WiFi Adaptors Mated to the Eoraptor (MK-36019) Robotics Control Platform

The RRCP allows for the control of multiple PWM servos via the I2C Master on the PIC16F1947. With remote commands, multiple Servos can be controlled through a wireless or direct RS-232 connection. In addition, a Sabertooth Motor controller can be controlled using the I2C Master for Rover motion via wireless or direct RS-232 connections.

The RRCP for the PIC16F1947 has been used to control both a BRAT Humanoid as well as a Rover. See IONOTRONICS Web Site for blue prints and video demonstrations.

The RRCP was developed by IONOTRONICS and is written in C using the CCS Development System for the PIC 8 bit processors. The RRCP is Open Source and is updated with new commands.

2 Commands

2.1 Identification and Test

Command	Return	Comments
tst	PIC16F1947 0.991\n\r	

2.1 I2C Multiple Servos Control

Command	Return	Comments
@ pi2cadd_0 pwm pi2add_1 pwm_1 ... pi2cadd_n-1 pwm_n-1 Tdddd	None	All I2C Servos paced by dddd ms. All I2C Addresses in 2 digit hexadecimal.

Example:

@ p3b 1800 p3c 2200 T1000

In this case the Servos connected to the PIC16F1825's at I2C addresses 0x3B and 0x3C are set to positions 1800 and 2200 respectively (in uSec). The total time for the maneuver is T=1000ms or 1Sec.

In the PIC16F1825 Firmware Time resolution is 20ms. So maximum time is 255*20ms

If greater than 255 set to 255.

If not found Time set to Zero.

This command is a very efficient way to control an Arm with 6 or more servos. The commands can be read from a file and sent to the Arm via the 32 bit PIC and controlled with the PIC16F1825 I2C PWM slaves. For example on a Rover multiple Arms can be controlled remotely.

Contact IONOTRONICS for a Java Application that sends these commands from a file to a serial port and paces them. This is great for local testing of for example multiple Arms without wireless. The *JavaRoboticsApp* also supports sending multiple commands read from a file.

2.2 SSC32 Servo Controller

Any command starting with “#” is sent to the Lynxmotion Serial SSC32. The line, up to “\n”, is sent.

Buffer limit is 120 characters. The text “\r\n” is sent to the SSC32.

Currently the Serial Baud Rate is 9600 bps from the PIC16F1947 to the SSC32.
The SSC32 must be setup for a Baud Rate of 9600.

Command	Return	Comments
# . . .	None	Sent directly to SS32 at 9600 bps

2.3 I2C LCD Commands

All command start with “lcd” followed by a command character and data.

Command	Return	Comments
lcdc	None	Clears LCD
lcds . . .	None	Any text after lcds is sent
lcdp xx yy		xx and yy are new position for the cursor. xx and yy with leading zero (e.g. 04)

2.4 Saber Servo Controller Through I2C 1825's

This command requires two PWM values for the Sabertooth Servo Controller.

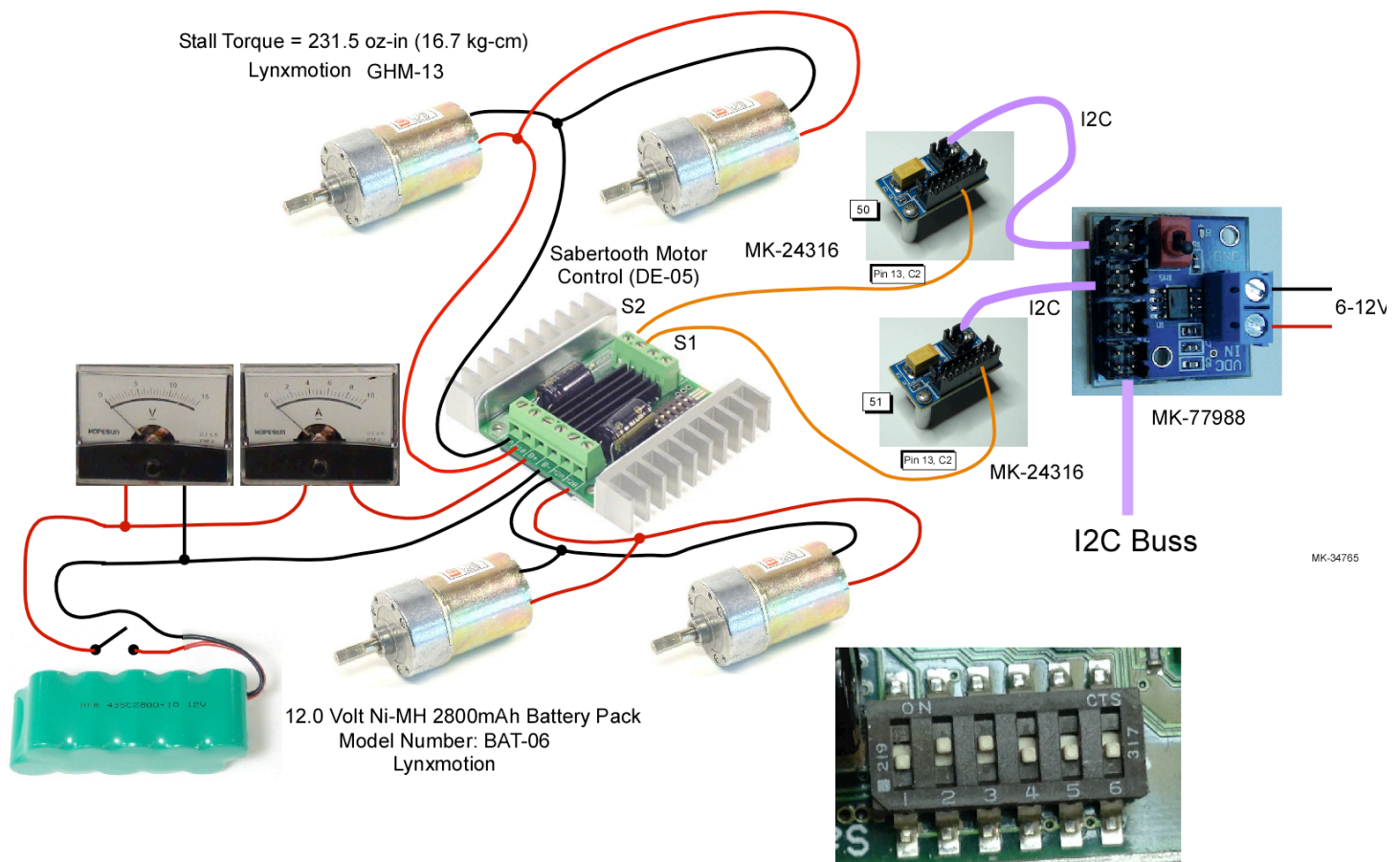
A dedicated I2C 16F1825 PIC is connected to each channel.

So two I2C 16F1825 PIC's are used to control the two channels of the Sabertooth Servo Controller.

Hardwired I2C Address is 0x50 for first channel

Hardwired I2C Address is 0x51 for second channel

Command	Return	Comments
sbr PWMValue_0 PWMValue_1	None	PWM Values 800 to 2600 uSec



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Figure 2 Sabertooth I2C Control with PIC16F1825

2.5 Servo Control via I2C 16F1825

Command	Return	Comments
servo i2c_address PWMValue	None	PWM Values 700 to 2600 uSec. I2C Address in HEX Two Digits

2.6 I2C Ultrasonic

Assumes Ultrasonic Sensor interfaced to PIC16F1825 with IONOTRONICS Firmware which makes the Ultrasonic Sensor an I2C Slave device.

Command	Return	Comments
uls i2c_address	uls=value	Returned value is 16 bit Hex. I2C Address Two Digit Hex (usually 3a).

2.7 Gyroscopes

IONOTRONICS ST L3G4200D Based 3-Axis Gyro (I2C Address 0x68) (MK-95157)

Command	Return	Comments
igyr	gyro_id=value	Returned value is 8 bit Hex. I2C Address Assumed to be 0x68. Id returned is 0xd3
igyv	vx=X:vy=Y:vz=Z:vt=TEMP	X,Y,Z and TEMP are 16 bit integers. They are separated by “:”

Note: Before reading the Gyro values you must send command “igyr” once. This will enable the device.

Note: *Not implemented yet.*

InvenSense ITG-3200 3 Axis Gyro (I2C Address 0x69)

Command	Return	Comments
gyr	Gyro_id=value	Returned value is 8 bit Hex. I2C Address Assumed to be 0x69.
gyv	vx=X:vy=Y:vz=Z:vt=TEMP	X,Y,Z and TEMP are 16 bit integers. They are separated by “:”

2.8 LED GPIO A0-A3

Command	Return	Comments
leda index	led=index	Sets bits A0-A3 based on index (1-4) Use index 0 to clear.

Note: Even though the command is called “leda” it is basically setting GPIO pins A0-A3 high based on index. Use index=0 to clear.

2.9 RGB

Command	Return	Comments
rgb index	void	Turns on Red Green Blue or Yellow LEDS on IONOTRONICS Debounce/RGBY Board MK-55856 based on index (1-4) Use index=0 to clear.

Note: Index=1, PIN C2 High, Index=2 Pin C1 High, Index=3 Pin F2 High, Index =4 Pin C3 High, Index=0, all pins Low (Clear RGB and Y LEDS on MK-55856 Board).

2.10 Read GPIO Port A 8 Bits

Command	Return	Comments
gpa	8 bit Port A in Hex	Reads all 8 bits port A GPIO

2.11 Read GPIO Port B 8 Bits

Command	Return	Comments
gpb	8 bit Port B in Hex	Reads all 8 bits port B GPIO

2.12 Read GPIO Port D 8 Bits

Command	Return	Comments
gpd	8 bit Port D	Reads all 8 bits port D GPIO

2.13 Meter Command (DAC Value)

Command	Return	Comments
dac dacValue	dacw=value	DAC Value between 0 and 255. If using the Pot/Meter based on I2C 4xADC/DAC then the meter is updated (255 full scale at 5V) 4xADC/DAC I2C address must be set to 0x4E

This command is very useful when the I2C Pot/Meter 4xADC/DAC is used. The DAC is connected to a 50uA meter through a precision 100KOhm resistor. So 5V is full scale. Very convenient way to display data to users through a meter. For example, Ultrasonic Reading or Infrared reading. Or for testing I2C bus.

2.14 Set ADC Channel

Command	Return	Comments
adh channel	Void	Set ADC channel for the I2C 4xADC/DAC at address 0x4E

2.15 Read ADC 8 bit Value (Channel Set by adh Command Default 0)

Command	Return	Comments
adc	Hex Value 8 bit	Reads only channel set by “adh” command (0 default) ADC value from the I2C 4xADC/DAC at address 0x4E

2.16 Read 4xADC Values (4 Channels 8 bits Each)

Command	Return	Comments
adc4	Hex Value 32 bit as 8 Hex digits two digits per reading (ASCII)	Reads all 4 ADC values from the I2C 4xADC/DAC at address 0x4E

2.17 Sonar Continuous Read and Output to Meter

The I2C 1825 based sonar measurement is read, scaled and displayed on the Meter. This is activated with the switch settings. Set the switch to 0x2 and reset.

2.18 Morse Code Send Text

Command	Return	Comments
mrs...		Pin B5 is Morse Code (Usually connected to IONOTRONICS Sidetone Generator). Text following "mrs" is sent. Example "mrsThis is a test" Each character is also sent to the I2C LCD.

2.19 Mose Code Timing Set

Command	Return	Comments
mrst morseTiming		Integer factor to change Morse Code Rate

2.20 Verbose On or Off

Command	Return	Comments
verb value	Debug echo of commands and other information	If value is "1" then turn verbose on. If "0" turn it off.

Note for many remote measurements make sure Verbose mode is off.

Note: *Not implemented yet.*

2.21 SPI

In development. Used to read manufacturer ID.

"spi"

spi_0=t0spi_1=t1spi2=t2spi_3=t3

SPI Value is 32 bit t3t2t1t0

To use the SPI EEPROM on the Eoraptor Robotic Control Platform jumper RG0 to MISO (RC4).

2.22 PIN

Command	Return	Comments
pin value	where value is either 0 or 1	Pin is B5

2.23 Analog Accelerometer

Command	Return	Comments
acc	X and Y returned as follows: x=X:y=Y where X and Y are 8 bit decimal values.	Assumes Accelerometer is connected to MK-34765 4 channel ADC (X,Y, and Z Axis) at I2C Address 0x4e

2.24 I2C 3-Axis Accelerometer

IONOTRONICS Analog Devices ADXL343 Based 3-Axis Accelerometer (I2C Address 0x53) MK-95157

Command	Return	Comments
iaci	acc_id=value	Returned value is 8 bit Hex. I2C Address Assumed to be 0x53. Id returned is 0xe5
igyv	vx=X:vy=Y:vz=Z:dmy=888	X,Y,Z are 16 bit integers.

Note: Before reading the Accelerometer values you must send command “iaci” once. This will enable the device.

2.25 Camera

Command	Return	Comments
cmr	Image encoded as ASCII Base64 Content-Transfer-Encoding standard	The Binary JPEG Image is converted to ASCII Base64 and sent back (serial).

Note: *Not implemented yet*

3 Switch Tests

Switch States:

4 States based on GPIO RD1-RD2.

Switch State	Test
0x00	Remote Control
0x01	Blink Red, Green, Blue and Yellow LEDS on Debounce/LED Board MK-55856
0x02	Ultrasonic Tight Loop (Read and display on Meter connected to DAC)
0x03	Blink Red, Green, Blue and Yellow LEDS on Debounce/LED Board MK-55856

4 GPIO Mapping to Eoraptor Robotics Platform

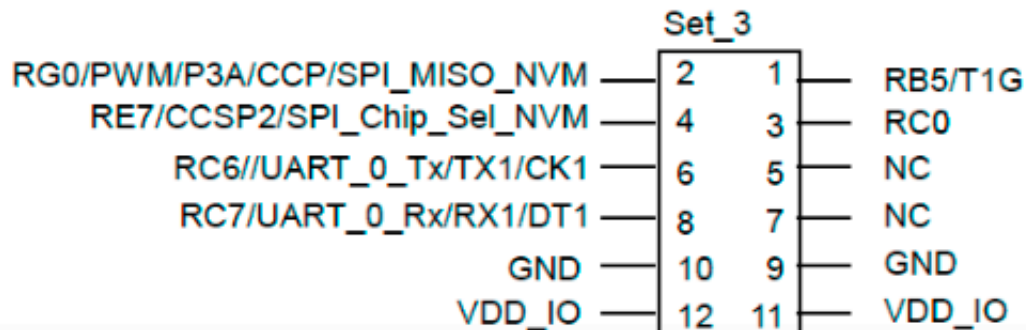
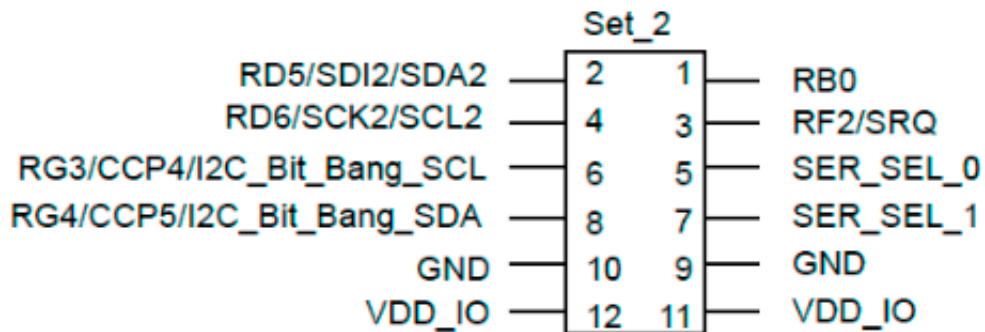
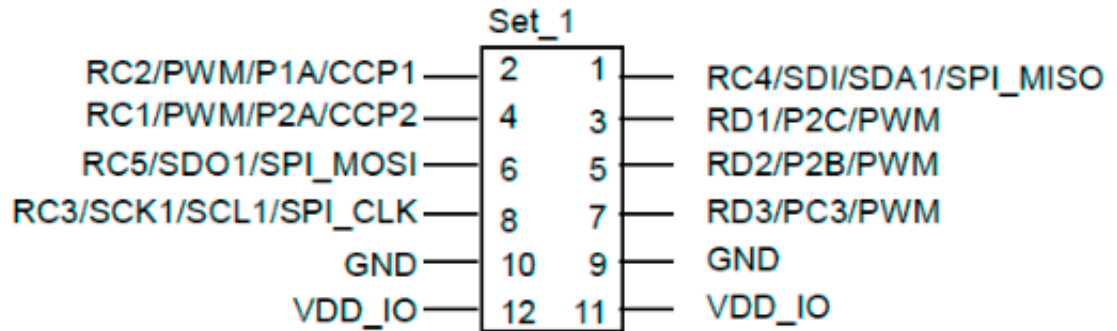
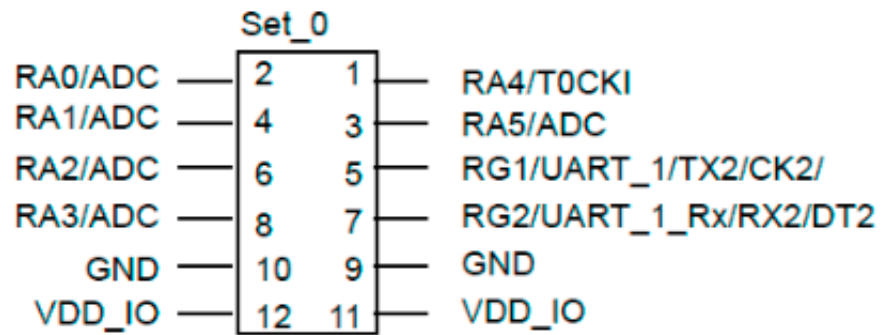


Figure 3 PIC16F1947 GPIO Mapping to Set 0 through Set3 12 pin DF11 Series Hirose Connectors on the Eororaptor

5 GPIO Mapping to Debounce Switches (Switch State) and LEDs

The following diagram should be used to connect the MK-55857 4 Debounce Switch and 4x LED Board. When followed, the commands will work to set the Red, Green, Blue and Yellow LEDs on and off as well as start up configuration for the two switch settings (self tests and remote control).

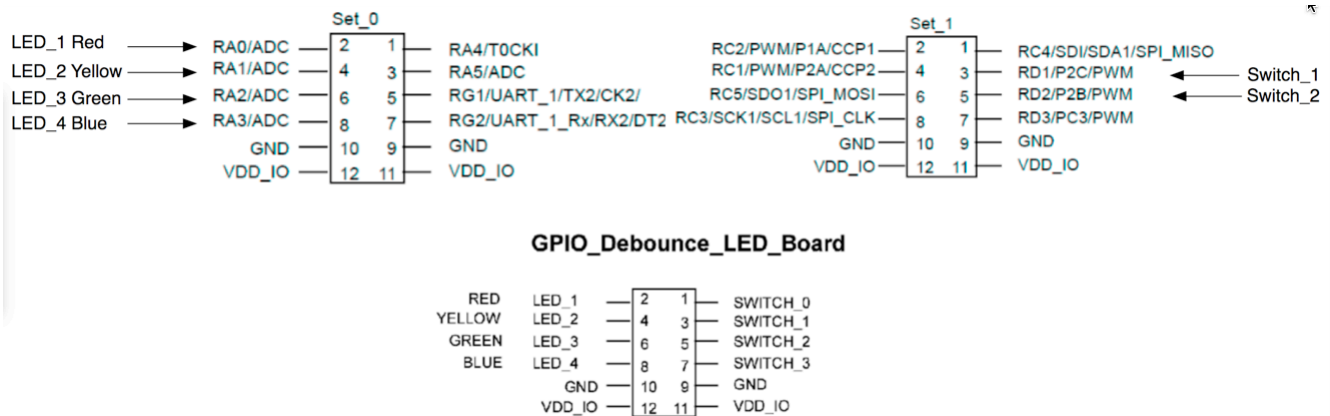


Figure 4 Connections to 4 Switch Debounce Board and 4 LEDs

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