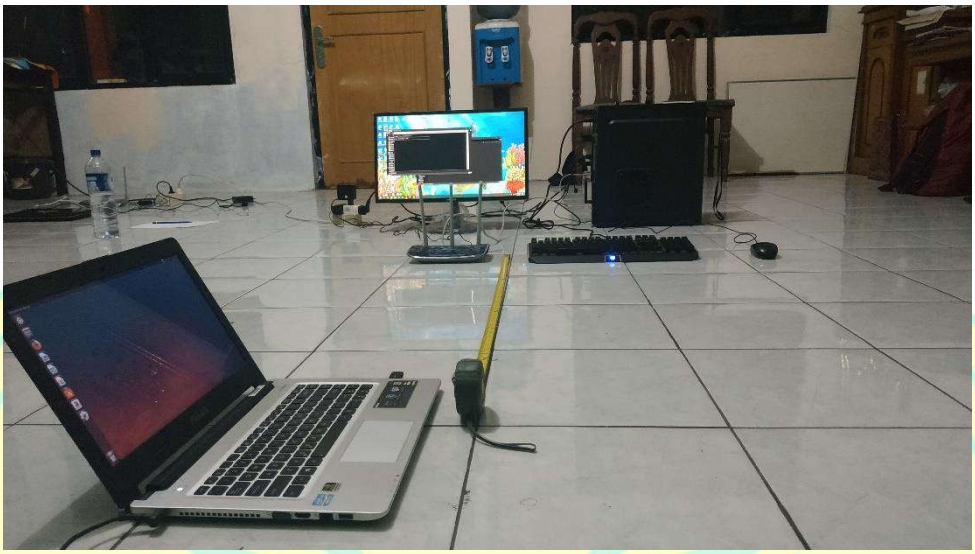
LAMPIRAN

Lampiran 1. Dokumentasi Pengambilan Data Pengukuran



Pengukuran pada kondisi tanpa interferensi, jarak *client* 1 meter dengan *access point*

Pengukuran pada kondisi interferensi *co-channel* dan *adjacent channel* secara bergantian, jarak *access point* yang menginterferensi sejauh 1 meter dari *access point* utama

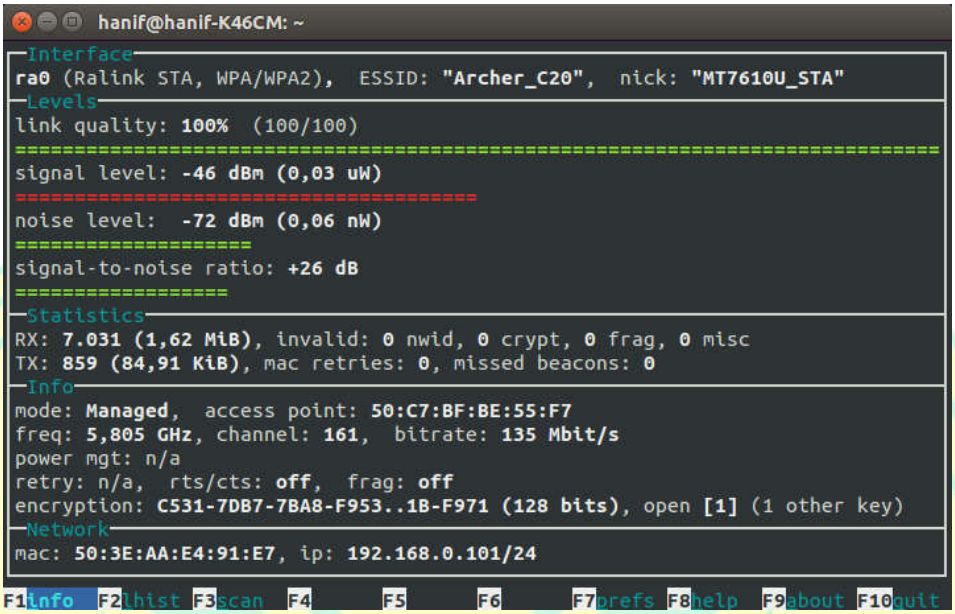
Pengukuran pada kondisi interferensi *co-channel* dan *adjacent channel* secara bergantian, jarak *access point* yang menginterferensi sejauh 2 meter dari *access point* utama

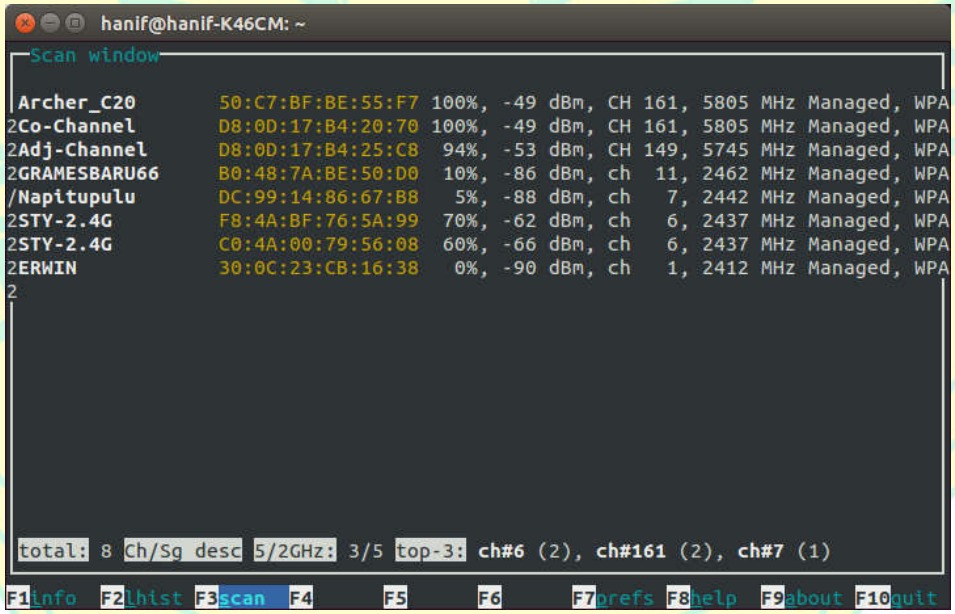
Pengukuran pada kondisi interferensi *co-channel* dan *adjacent channel* secara bergantian, jarak *access point* yang menginterferensi sejauh 3 meter dari *access point* utama

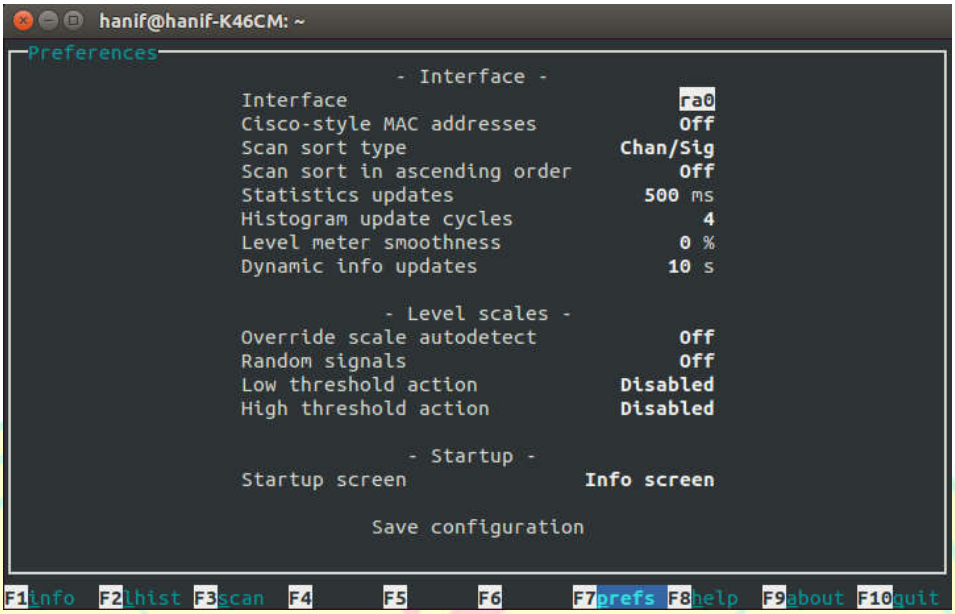
Pengukuran pada kondisi interferensi *co-channel* dan *adjacent channel*

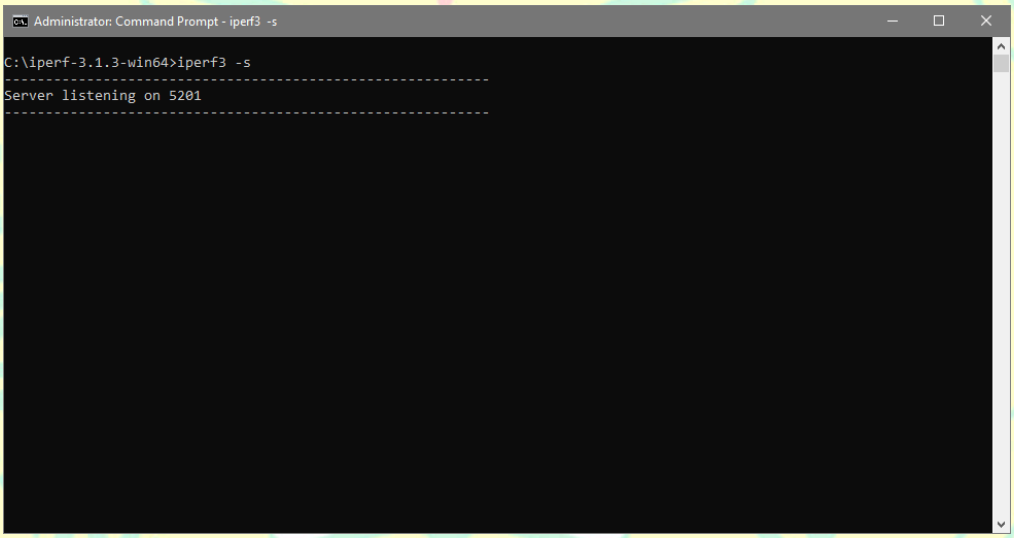
Pengukuran pada kondisi interferensi *co-channel* dan *adjacent channel*

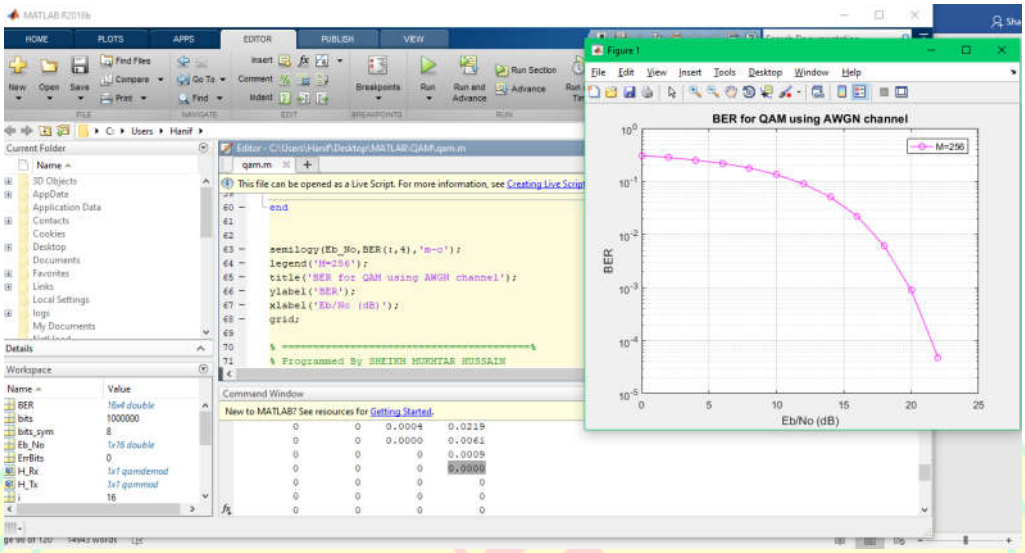
Lampiran 2. Dokumentasi Aplikasi Wavemon, iPerf3, dan MATLAB






hanif@hanif-K46CM: ~
Preferences
- Interface -
Interface ra0
Cisco-style MAC addresses Off
Scan sort type Chan/Sig
Scan sort in ascending order Off
Statistics updates 500 ms
Histogram update cycles 4
Level meter smoothness 0 %
Dynamic info updates 10 s
- Level scales -
Override scale autodetect Off
Random signals Off
Low threshold action Disabled
High threshold action Disabled
- Startup -
Startup screen Info screen
Save configuration
F1info F2lhist F3scan F4 F5 F6 F7prefs F8help F9about F10quit


Administrator: Command Prompt - iperf3 -s
C:\iperf-3.1.3-win64>iperf3 -s
Server listening on 5201


BER for QAM using AWGN channel
M=256
BER
Eb/No (dB)

Lampiran 3. *Source Code* MATLAB Simulasi BER pada Modulasi QAM dengan *channel* AWGN

```
%--------------------------------------------------
File qam.m
%--------------------------------------------------
%% BER COMPARISON of different M-ary QAM

% ----------------------------------------%
% User Defined Functions used in this Files are
% s2p --> Serial to Parallel Conversion
% p2s --> Parallel to Serial Conversion
% ----------------------------------------%

clc;
clear all;
close all;

bits = 1.e6;
msg  = round(rand(1,bits));                    % Generating Random Bit Stream
M = [4 16 64 256];                             % M-ary


for j=1:4

% ---------------------------------- Tx ----------------------------------------%

%% 16-QAM Modulation

bits_sym = log2(M(j));                         % Bits per Symbol for M-ary
sym_tx = s2p(msg,bits_sym);                    % Serial to Parallel Conversion for QAM

H_Tx = modem.qammod('M', M(j), 'PHASEOFFSET', 0, 'SYMBOLORDER', 'BINARY', ...
                                                'INPUTTYPE', 'BIT');   % Generate
                                                Handle for Modulation
qam_tx = modulate(H_Tx,sym_tx);                                        % Modulation

%----------------------------------- CHANNEL ------------------------------------%

Eb_No = 0:2:30;
SNR = Eb_No + 10*log10(log2(M(j)));                                    % Finding
out SNR from Eb/No

for i=1:length(Eb_No)

    qam_n = awgn(qam_tx,SNR(i),'measured');    % Adding AWGN

    % ---------------------------------- Rx ----------------------------------------%

%% QAM De-Modulation

qam_rx = p2s(qam_n);
H_Rx = modem.qamdemod('M', M(j), 'PHASEOFFSET', 0, 'SYMBOLORDER', 'BINARY', ...
                'OUTPUTTYPE', 'BIT');          % Generate Handle for Modulation
sym_rx = demodulate(H_Rx,qam_rx);              % Modulating data to QAM

%% Symbols to Msg Conversion

msg_rx = p2s(sym_rx);
msg_rx = msg_rx(1,1:length(msg));

[ErrBits BER(i,j)] = symerr(msg_rx,msg);       % Calculating BER by comparisson of Rx
and Tx msg

%%  Plot of  BER vs Eb/No
end

end


semilogy(Eb_No,BER(:,1),'r-*',Eb_No,BER(:,2),'b-v',Eb_No,BER(:,3),'y-s',Eb_No,BER(:,4),'m
-o');
```

```
66  legend('M-4','M-16','M-64','M-256');
67  title('BER for QAM using AWGN channel');
68  ylabel('BER');
69  xlabel('Eb/No (dB)');
70  grid;
71
72  ------------------------------------------------
73  File s2p.m
74  ------------------------------------------------
75  %% Function Serial to Parallel I/P msg and No. of Parallel Channels
76
77  function p_data = s2p(s_data,N)
78      l = length(s_data);
79      mode = mod(l,N);
80      if mode ~= 0
81          z_add = zeros(1,N-mode);
82          data = [s_data z_add];
83      else
84          data = s_data;
85      end
86
87      M = length(data)/N;
88      p_data = reshape(data,N,M);
89  end
90
91  ------------------------------------------------
92  File p2s.m
93  ------------------------------------------------
94  %% Function Parallel to Serial
95
96  function s_data = p2s(data)
97      data1 = data(:);
98      s_data = data1.';
99  end
```

Lampiran 4. Tabel Perhitungan dan Analisis Data Penelitian

Tabel Data Analisis Interferensi Co-Channel dan Adjacent Channel terhadap kualitas jaringan Wi-Fi pada Frekuensi ISM 5.8GHz dengan standar 802.11ac

Kondisi Tidak Ada Interferensi											
			Pengukuran					Analisis			
Jarak AP Interferensi	Channel AP Sistem	RSSI (dBm)	Noise (dBm)	SNR Pengukuran (dB)	Percobaan iPerf Ke	iPerf3 Up (Mb/s)	iPerf3 Down (Mb/s)	iPerf3 Retr	SNR Perhitungan (dB)	Eb/N0	x	Q(x)	BER 256-QAM
x	161	-46	-72	26	1	89.5	89.3	0	26	18.67	1.326	0.0925	0.043359375

Kondisi Interferensi Co-Channel													
		Pengukuran							Analisis				
Jarak AP Co-Ch	Channel AP Co	RSSI (dBm)	Noise (dBm)	SNR Pengukuran (dB)	Percobaan iPerf Ke	iPerf3 Up (Mb/s)	iPerf3 Down (Mb/s)	iPerf3 Retr	SNR Perhitungan (dB)	Eb/N0	x	Q(x)	BER 256-QAM
1	161	-49	-67	18	1	54.5	54.4	0	17.9	10.57	0.997	0.15925	0.074684375
1					2	68	67.8	0					
1					3	64.6	64.4	0					
2		-44	-65	21	1	49.2	49	3	21	13.67	1.134	0.12835	0.060164062
2					2	61.8	61.7	0					
2					3	52.6	52.4	0					
3		-38	-61	23	1	57.5	57.4	0	23	15.67	1.214	0.11235	0.052664062
3					2	52.1	52	0					
3					3	51.6	51.4	2					

Tabel Data Analisis Interferensi Co-Channel dan Adjacent Channel terhadap kualitas jaringan Wi-Fi pada Frekuensi ISM 5.8GHz dengan standar 802.11ac

Kondisi Interferensi Adjacent Channel														
Pengukuran									Analisis					
Jarak AP Adj-Ch	Channel AP Adj	RSSI (dBm)	Noise (dBm)	SNR Pengukuran (dB)	Percobaan iPerf Ke	iPerf3 Up (Mb/s)	iPerf3 Down (Mb/s)	iPerf3 Retr	SNR Perhitungan (dB)	Eb/N0	x	Q(x)	BER 256-QAM
1	157	-42	-65	23	1	69	68.9	0	23	15.67	1.214	0.11235	0.0526640625
1					2	68.3	68.2	0					
1					3	63.2	63	0					
2		-46	-68	22	1	49	48.9	2	22	14.67	1.175	0.12	0.05625
2					2	63.4	63.3	0					
2					3	54.4	54.3	0					
3		-40	-65	25	1	6.65	6.63	152	25	17.67	1.29	0.0986	0.04621875
3					2	50.9	50.8	0					
3					3	64.1	64	0					
1	149	-52	-74	22	1	17.5	17.4	78	21.9	14.57	1.171	0.12080	0.056625
1					2	5.08	5.06	506					
1					3	2.95	2.94	495					
2		-44	-67	23	1	11.4	11.3	302	23	15.67	1.214	0.11235	0.0526640625
2					2	2.37	x	702					
2					3	x	x	x					
3		-47	-70	23	1	2.28	2.27	723	23	15.67	1.214	0.11235	0.0526640625
3					2	x	x	x					
3					3	x	x	x					

Tabel Data Analisis Interferensi Co-Channel dan Adjacent Channel terhadap kualitas jaringan Wi-Fi pada Frekuensi ISM 5.8GHz dengan standar 802.11ac

Kondisi Interferensi Co-Channel dan Adjacent Channel													
Pengukuran									Analisis				
Jarak AP Co dan Adj-Ch	Channel AP Co dan Adj	RSSI (dBm)	Noise (dBm)	SNR Pengukuran (dB)	Percobaan iPerf Ke	iPerf3 Up (Mb/s)	iPerf3 Down (Mb/s)	iPerf3 Retr	SNR Perhitungan (dB)	Eb/N0	x	Q(x)	BER 256-QAM
1	Co : 161, Adj : 157	-46	-63	17	1	4.49	4.48	465	17	9.67	0.954	0.17005	0.0797109375
1					2	8.99	8.96	128					
1					3	4.13	4.12	36					
2		-44	-63	19	1	79.5	79.3	0	19	11.67	1.048	0.1473	0.069046875
2					2	5.24	5.21	304					
2					3	39.9	39.8	4					
3		-47	-68	21	1	69.1	68.9	0	21	13.67	1.134	0.12835	0.0601640625
3					2	58.5	58.3	0					
3					3	61.5	61.3	0					
1	Co : 161, Adj : 149	-41	-59	18	1	17.6	17.5	245	18	10.67	1.002	0.15815	0.0741328125
1					2	6.98	6.96	255					
1					3	1.73	1.72	489					
2		-45	-64	19	1	13.1	13.1	64	19	11.67	1.048	0.1473	0.069046875
2					2	5.02	5	294					
2					3	4.42	4.4	381					
3		-42	-63	21	1	1.12	x	462	21	13.67	1.134	0.12835	0.0601640625
3					2	x	x	x					
3					3	x	x	x					

Lampiran 5. Tabel Q *Function*

E&CE 411, Spring 2009, Table of Q Function

Table 1: Values of $Q(x)$ for $0 \leq x \leq 9$

x	$Q(x)$	x	$Q(x)$	x	$Q(x)$	x	$Q(x)$
0.00	0.5	2.30	0.010724	4.55	2.6823×10^{-6}	6.80	5.231×10^{-12}
0.05	0.48006	2.35	0.0093867	4.60	2.1125×10^{-6}	6.85	3.6925×10^{-12}
0.10	0.46017	2.40	0.0081975	4.65	1.6597×10^{-6}	6.90	2.6001×10^{-12}
0.15	0.44038	2.45	0.0071428	4.70	1.3008×10^{-6}	6.95	1.8264×10^{-12}
0.20	0.42074	2.50	0.0062097	4.75	1.0171×10^{-6}	7.00	1.2798×10^{-12}
0.25	0.40129	2.55	0.0053861	4.80	7.9333×10^{-7}	7.05	8.9459×10^{-13}
0.30	0.38209	2.60	0.0046612	4.85	6.1731×10^{-7}	7.10	6.2378×10^{-13}
0.35	0.36317	2.65	0.0040246	4.90	4.7918×10^{-7}	7.15	4.3389×10^{-13}
0.40	0.34458	2.70	0.003467	4.95	3.7107×10^{-7}	7.20	3.0106×10^{-13}
0.45	0.32636	2.75	0.0029798	5.00	2.8665×10^{-7}	7.25	2.0839×10^{-13}
0.50	0.30854	2.80	0.0025551	5.05	2.2091×10^{-7}	7.30	1.4388×10^{-13}
0.55	0.29116	2.85	0.002186	5.10	1.6983×10^{-7}	7.35	9.9103×10^{-14}
0.60	0.27425	2.90	0.0018658	5.15	1.3024×10^{-7}	7.40	6.8092×10^{-14}
0.65	0.25785	2.95	0.0015889	5.20	9.9644×10^{-8}	7.45	4.667×10^{-14}
0.70	0.24196	3.00	0.0013499	5.25	7.605×10^{-8}	7.50	3.1909×10^{-14}
0.75	0.22663	3.05	0.0011442	5.30	5.7901×10^{-8}	7.55	2.1763×10^{-14}
0.80	0.21186	3.10	0.0009676	5.35	4.3977×10^{-8}	7.60	1.4807×10^{-14}
0.85	0.19766	3.15	0.00081635	5.40	3.332×10^{-8}	7.65	1.0049×10^{-14}
0.90	0.18406	3.20	0.00068714	5.45	2.5185×10^{-8}	7.70	6.8033×10^{-15}
0.95	0.17106	3.25	0.00057703	5.50	1.899×10^{-8}	7.75	4.5946×10^{-15}
1.00	0.15866	3.30	0.00048342	5.55	1.4283×10^{-8}	7.80	3.0954×10^{-15}
1.05	0.14686	3.35	0.00040406	5.60	1.0718×10^{-8}	7.85	2.0802×10^{-15}
1.10	0.13567	3.40	0.00033693	5.65	8.0224×10^{-9}	7.90	1.3945×10^{-15}
1.15	0.12507	3.45	0.00028029	5.70	5.9904×10^{-9}	7.95	9.3256×10^{-16}
1.20	0.11507	3.50	0.00023263	5.75	4.4622×10^{-9}	8.00	6.221×10^{-16}
1.25	0.10565	3.55	0.00019262	5.80	3.3157×10^{-9}	8.05	4.1397×10^{-16}
1.30	0.0968	3.60	0.00015911	5.85	2.4579×10^{-9}	8.10	2.748×10^{-16}
1.35	0.088508	3.65	0.00013112	5.90	1.8175×10^{-9}	8.15	1.8196×10^{-16}
1.40	0.080757	3.70	0.0001078	5.95	1.3407×10^{-9}	8.20	1.2019×10^{-16}
1.45	0.073529	3.75	8.8417×10^{-5}	6.00	9.8659×10^{-10}	8.25	7.9197×10^{-17}
1.50	0.066807	3.80	7.2348×10^{-5}	6.05	7.2423×10^{-10}	8.30	5.2056×10^{-17}
1.55	0.060571	3.85	5.9059×10^{-5}	6.10	5.3034×10^{-10}	8.35	3.4131×10^{-17}
1.60	0.054799	3.90	4.8096×10^{-5}	6.15	3.8741×10^{-10}	8.40	2.2324×10^{-17}
1.65	0.049471	3.95	3.9076×10^{-5}	6.20	2.8232×10^{-10}	8.45	1.4565×10^{-17}
1.70	0.044565	4.00	3.1671×10^{-5}	6.25	2.0523×10^{-10}	8.50	9.4795×10^{-18}
1.75	0.040059	4.05	2.5609×10^{-5}	6.30	1.4882×10^{-10}	8.55	6.1544×10^{-18}
1.80	0.03593	4.10	2.0658×10^{-5}	6.35	1.0766×10^{-10}	8.60	3.9858×10^{-18}
1.85	0.032157	4.15	1.6624×10^{-5}	6.40	7.7688×10^{-11}	8.65	2.575×10^{-18}
1.90	0.028717	4.20	1.3346×10^{-5}	6.45	5.5925×10^{-11}	8.70	1.6594×10^{-18}
1.95	0.025588	4.25	1.0689×10^{-5}	6.50	4.016×10^{-11}	8.75	1.0668×10^{-18}
2.00	0.02275	4.30	8.5399×10^{-6}	6.55	2.8769×10^{-11}	8.80	6.8408×10^{-19}
2.05	0.020182	4.35	6.8069×10^{-6}	6.60	2.0558×10^{-11}	8.85	4.376×10^{-19}
2.10	0.017864	4.40	5.4125×10^{-6}	6.65	1.4655×10^{-11}	8.90	2.7923×10^{-19}
2.15	0.015778	4.45	4.2935×10^{-6}	6.70	1.0421×10^{-11}	8.95	1.7774×10^{-19}
2.20	0.013903	4.50	3.3977×10^{-6}	6.75	7.3923×10^{-12}	9.00	1.1286×10^{-19}
2.25	0.012224						

Lampiran 6. Datasheet

tp-link

AC750 Wireless Dual Band Router

Upgrade to AC Wi-Fi for Fast Connections

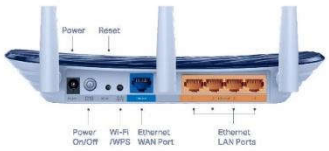
Archer C20

300Mbps + 433Mbps Dual Band Wi-Fi | Easy Setup | Superior Coverage

Specifications

Hardware

- Ethernet Ports: 4*10/100Mbps LAN Ports, 1*10/100Mbps WAN Port
- Buttons: Reset Button, Power On/Off Button, Wi-Fi/WPS Button
- Antennas: 3 fixed Omni Directional Antennas
- External Power Supply: 9VDC/0.6A(CE), 9VDC/0.85A(FCC)
- Dimensions (W x D x H): 9.1 x 5.7 x 1.4 in. (230 x 144 x 35mm)



Wireless

- Wireless Standards: IEEE 802.11ac/n/a 5GHz, IEEE 802.11b/g/n 2.4GHz
- Frequency: 2.4GHz and 5GHz
- Signal Rate:
  - 5GHz: Up to 433Mbps
  - 2.4GHz: Up to 300Mbps
- Reception Sensitivity:
  - 5GHz:
  - 11a 54M: -76dBm; 11ac VHT20 MCS8: -70dBm;
  - 11ac VHT40 MCS9: -65.5dBm; 11ac VHT80 MCS9: -61.5dBm
  - 2.4GHz:
  - 11g 54M: -76dBm11n; HT20 MCS7: -74dBm;
  - 11n HT40 MCS7: -71dBm
- Wireless Function: Enable/Disable Wireless Radio, WDS Bridge, WMM, Wireless Statistics
- Wireless Security: 64/128-bit WEP,WPA / WPA2,WPA-PSK/ WPA2-PSK encryption

Specifications

Software

WAN Type: Dynamic IP, Static IP, PPPoE, PPTP(Dual Access), L2TP(Dual Access), Bigpond

DHCP: Server, DHCP Client List, Address Reservation

Quality of Service: WMM, Bandwidth Control

Port Forwarding: Virtual Server, Port Triggering, UPnP, DMZ

Dynamic DNS: DynDns, NO-IP

Access Control: Parental Control, Local Management Control, Host list, Access Schedule, Rule Management

Firewall Security: DoS, SPI Firewall, IP Address Filter/MAC Address Filter/Domain Filter, IP and MAC Address Binding

Protocols: IPv4, IPv6

Management: Access Control, Local Management, Remote Management

Guest Network: 2.4GHz guest network, 5GHz guest network

Others

- Certification
  - CE, FCC, RoHS, Wi-Fi
- System Requirements
  - Microsoft Windows 10/8.1/8/7/Vista/XP/2000/NT/98SE, MAC OS, NetWare, UNIX or Linux
  - Internet Explorer 11, Firefox 12.0, Chrome 20.0, Safari 4.0, or other Java-enabled browser
  - Cable or DSL Modem
  - Subscription with an Internet Service Provider (for internet access)
- Environment
  - Operating Temperature: 0℃~40℃ (32℉~104℉)
  - Storage Temperature: -40℃~70℃ (-40℉~158℉)
  - Operating Humidity: 10%~90% non-condensing
  - Storage Humidity: 5%~90% non-condensing
- Package Contents
  - Wireless Router Archer C20
  - Power Adapter
  - RJ-45 Ethernet Cable
  - Quick Installation Guide

For more information, please visit
http://www.tp-link.com/products/details/Archer-C20.html
or scan the QR code left.

www.tp-link.com

TP-LINK®

AC600 Wireless Dual Band USB Adapter

Archer T2U

Features:

- Selectable Dual Band connections for lag-free HD video streaming and gaming
- AC600 (433+150) Mbps wireless speed with 802.11ac
- A tiny way to get speedy next generation Wi-Fi connections
- WPA/WPA2-PSK encryptions provide your network with active defense against security threats
- Bundled utility enables easy management
- Compatible with IEEE 802.11a/b/g/n/ac
- Supports Windows 8/7/XP

Description:

TP-LINK's Archer T2U is an AC600 Wireless Dual Band USB Adapter comes with the next generation Wi-Fi standard – 802.11ac, 3 times speeds of wireless N speeds, providing selectable 5 GHz and 2.4 GHz bands for the latest standard and backward compatibility to existing Wi-Fi network. With 433Mbps wireless speeds over the crystal clear 5GHz band or 150Mbps over the 2.4GHz band, the Archer T2U is the superior choice for seamless HD streaming, online gaming and other bandwidth-intensive tasks.

Specifications:

HARDWARE FEATURES	
Interface	USB 2.0
Dimensions (W X D X H)	1.6x0.7x0.3 in. (41x19.5x8.7mm)
Antenna Type	Omni Directional
Wireless Standards	IEEE 802.11a, IEEE 802.11ac, IEEE 802.11b, IEEE 802.11g, IEEE 802.11n

www.tp-link.com

AC600 Wireless Dual Band USB Adapter — Archer T2U

Frequency	5GHz 2.4GHz	
Signal Rate	5GHz 11ac: Up to 433Mbps(dynamic) 11a: Up to 54Mbps(dynamic) 2.4GHz 11n: Up to 150Mbps(dynamic) 11g: Up to 54Mbps(dynamic) 11b: Up to 11Mbps(dynamic)	
EIRP	<20dBm (EIRP)	
Reception Sensitivity	5GHz: 11a 6Mbps: -94dBm 11a 54Mbps: -78dBm 11n HT20 MCS0: -94dBm 11n HT20 MCS7: -77dBm 11n HT40 MCS0: -92dBm 11n HT40 MCS7: -74dBm 11ac VHT80 MCS0: -89dBm 11ac VHT80 MCS9: -64dBm	2.4GHz: 11b 1Mbps: -99dBm 11b 11Mbps: -91dBm 11g 6Mbps: -94dBm 11g 54Mbps: -77dBm 11n HT20 MCS0: -95dBm 11n HT20 MCS7: -76dBm 11n HT40 MCS0: -92dBm 11n HT40 MCS7: -73dBm
Wireless Modes	Ad-Hoc / Infrastructure mode	
Wireless Security	Support 64/128 bit WEP, WPA-PSK/WPA2-PSK,802.1x	
Modulation Technology	DBPSK, DQPSK, CCK, OFDM, 16-QAM, 64-QAM, 256-QAM	
OTHERS		
Certification	CE, FCC, RoHS	
Package Contents	Wireless Adapter Archer T2U Resource CD Quick Installation Guide	
System Requirements	Windows 8/7/XP 32/64bits	
Environment	Operating Temperature: 0℃~40℃ (32℉~104℉) Storage Temperature: -40℃~70℃ (-40℉~158℉) Operating Humidity: 10%~90% non-condensing Storage Humidity: 5%~90% non-condensing	

Diagram:

Package:

- AC600 Wireless Dual Band USB Adapter Archer T2U
- Quick Installation Guide
- Resource CD

Related Products:

- AC1200 High Gain Wireless Dual Band USB Adapter Archer T4UH
- AC1200 Wireless Dual Band USB Adapter Archer T4U
- AC600 High Gain Wireless Dual Band USB Adapter Archer T2UH

www.tp-link.com