ABB MEASUREMENT & ANALYTICS | TECHNICAL DESCRIPTION

Advanced Ethernet Parameter Description

XSeries^{G5}, RMC, µFLO^{G5}

MARCH 2019 | 2105999MNAA

1 Terms and definitions

Term	Definitions
Network Bandwidth	The maximum amount of data that can be transmitted in a fixed amount of time. It is usually measured in bits per second (bps).
Duplex Mode	Full-Duplex mode is a bi-directional communication that allows communication in both directions at the same time. Half-Duplex mode is also bi-directional communication but allows communications only in one direction at a time.
Auto Negotiation	A signaling mechanism used by Ethernet over twisted pair by which two connected devices choose common transmission parameters such as speed, duplex mode, flow control.
Data Rate Limit	The maximum rate at which data can be transferred within a device or between Ethernet and microprocessor. It is usually measured in bits per second (bps).

2 Introduction

New advanced Ethernet features have been implemented in RMC-100, µFLO^{G5} and XSeries ^{G5} products related to Ethernet and cyber security concerns. These new features allow monitoring and control of the traffic on the Ethernet port(s). They provide statistics that can help users and developers diagnose Ethernet problems. A performance analysis of the Ethernet and recommendations for how to use the Ethernet efficiently without problems is also provided.

3 Features

Review the table below to determine the features that are supported by product.

Table 3-1: Supported Ethernet features per product

Product	Embedded Software Revision	Ethernet bandwidth setting	Ethernet data rate limiting	Ethernet usage statistics
RMC-100	2105457-026	NO	YES	YES
XFC^{G5}	2105805-005	YES	NO	YES
XRC ^{G5}	2105864-005	YES	NO	YES
µFLO ^{G5}	2105298-013	YES	NO	YES
PCCU	2103445-085	YES	YES	YES

3.1 Ethernet bandwidth parameter description

Ethernet bandwidth settings are now available in the interface. Users can set the Ethernet bandwidth and the duplex mode depending upon the other devices (switches etc.) in the network. Auto negotiation is always enabled on Ethernet.

For example, if the Ethernet speed is set to 100 Mbps, and the device is connected to a 10 Mbps switch on the other end, the operating speed will be negotiated to 10 Mbps.

Table 3-2: Ethernet bandwidth registers

Parameter	Description	Register	Access	Type	Valid Values	Default Value
Ethernet Speed	The desired speed of the Ethernet interface	0.40.7	RW	UINT32	10 -> 10 Mbps 100 -> 100 Mbps	100 -> 100 Mbps for RMC; 10 -> 10 Mbps for XFC^{G5}, XRC ^{G5} and µFlo^{G5}

Duplex Mode	The desired duplex mode	0.40.8	RW	UINT32	1 -> Half Duplex 2 -> Full Duplex	1 -> Full Duplex
Operating Ethernet Speed	The operating speed of the Ethernet after negotiation	0.40.9	RO	UINT32	0 -> Unknown 1 -> 1 Mbps 10 -> 10 Mbps 100 -> 100 Mbps	Negotiated Speed
Operating Duplex Mode	Operating Duplex mode after negotiation	0.40.10	RO	UINT32	0 -> Unknown 1 -> Half Duplex 2 -> Full Duplex	Negotiated Duplex Mode

3.2 Ethernet data rate limiting

Ethernet data rate limiting allows the user to set rate limits on incoming and outgoing Ethernet traffic processed by the CPU on a per port basis without changing the bandwidth of the Ethernet interface.

- For Rx Rate Limit, packets are dropped at the port when the data rate exceeds the specified rate limit.
- For Tx Rate Limit, the throughput of the Ethernet is limited by the specified rate limit.

The following registers have been added to the Ethernet tab for Communications.

Table 3-3: Ethernet data rate limiting registers

Parameter	Description	Register	Access	Type	Valid Values	Default Value
Port 1 – Rate Limit Rx	Incoming rate limit in bits per second for Port 1	0.40.1	RW	UINT32	64 -> 64 Kbps 128 -> 128 Kbps 192 -> 192 Kbps 256 -> 256 Kbps 512 -> 512 Kbps 1000 -> 1 Mbps 5000 -> 5 Mbps 10000 -> 10 Mbps 20000 -> 20 Mbps 30000 -> 30 Mbps 40000 -> 40 Mbps 50000 -> 50 Mbps 100000 -> Off (100 Mbps)	10000 -> 10 Mbps
Port 1 – Rate Limit Tx	Outcoming rate limit in bits per second for Port 1. The transmit rate limit is common for all the ports. Changing for one port applies to other ports as well.	0.40.2	RW	UINT32	64 -> 64 Kbps 128 -> 128 Kbps 192 -> 192 Kbps 256 -> 256 Kbps 512 -> 512 Kbps 1000 -> 1 Mbps 5000 -> 5 Mbps 10000 -> 10 Mbps 20000 -> 20 Mbps 30000 -> 30 Mbps 40000 -> 40 Mbps 50000 -> 50 Mbps 100000 -> Off (100 Mbps)	10000 -> 10 Mbps
Port 2 – Rate Limit Rx	Incoming rate limit in bits per second for Port 2	0.40.101	RW	UINT32	64 -> 64 Kbps 128 -> 128 Kbps 192 -> 192 Kbps 256 -> 256 Kbps 512 -> 512 Kbps 1000 -> 1 Mbps 5000 -> 5 Mbps 10000 -> 10 Mbps 20000 -> 20 Mbps 30000 -> 30 Mbps 40000 -> 40 Mbps 50000 -> 50 Mbps 100000 -> Off (100 Mbps)	10000 -> 10 Mbps

Parameter	Description	Register	Access	Type	Valid Values	Default Value
Port 2 – Rate Limit Tx	Outcoming rate limit in bits per second for Port 2. The transmit rate limit is common for all the ports. Changing for one port applies to other ports as well.	0.40.102	RW	UINT32	64 -> 64 Kbps 128 -> 128 Kbps 192 -> 192 Kbps 256 -> 256 Kbps 512 -> 512 Kbps 1000 -> 1 Mbps 5000 -> 5 Mbps 10000 -> 10 Mbps 20000 -> 20 Mbps 30000 -> 30 Mbps 40000 -> 40 Mbps 50000 -> 50 Mbps 100000 -> Off (100 Mbps)	10000 -> 10 Mbps

3.3 Ethernet usage statistics

Ethernet usage statistics allow for monitoring the traffic on the Ethernet for bandwidth use, dropped packets or error packets. Users can trend these parameters to get a historical view of the Ethernet activity.

Table 3-4: Ethernet usage statistics registers

Parameter	Description	Register	Access	Type	Valid Values	Default Value
Receive Ethernet Usage (%)	Percentage utilization of the Rx bandwidth	0.10.4	RO	FLOAT	0 to 100%	Current Value
Transmit Ethernet Usage (%)	Percentage utilization of the Tx bandwidth	0.10.6	RO	FLOAT	0 to 100%	Current Value
Rx Date Rate (bps)	Rate of incoming data in bits per second. It should always be less than or equal to Rx Data Rate Limit.	0.9.76	RO	UINT32	0 to Rx Bandwidth	Current Value
Tx Date Rate (bps)	Rate of outgoing data in bits per second. It should always be less than or equal to Tx Data Rate Limit.	0.9.77	RO	UINT32	0 to Tx Bandwidth	Current Value
Total Data Rate (bps)	Rate of incoming + outgoing data in bits per second	0.9.78	RO	UINT32	0 to Rx+Tx Bandwidth	Current Value
Rx Dropped Packet Rate (pkt/sec)	Number of incoming packets dropped per second because Rx Data Rate exceeds Rx Data Rate Limit	0.9.79	RO	UINT32	0 to MAX (UINT32)	Current Value
Tx Dropped Packet Rate (pkt/sec)	Number of outgoing packets dropped per second because Tx Data Rate exceeds Tx Data Rate Limit	0.9.80	RO	UINT32	0 to MAX (UINT32)	Current Value
Rx Packet Rate (pkt/sec)	Number of packets received per second	0.9.81	RO	UINT32	0 to MAX (UINT32)	Current Value
Tx Packet Rate (pkt/sec)	Number of packets sent per second	0.9.82	RO	UINT32	0 to MAX (UINT32)	Current Value
Rx Error Rate (pkt/sec)	Number of error packets received per second	0.9.83	RO	UINT32	0 to MAX (UINT32)	Current Value
Tx Error Rate	Number of packets per second could not be	0.9.84	RO	UINT32	0 to MAX (UINT32)	Current Value

Parameter	Description	Register	Access	Type	Valid Values	Default Value
(pkt/sec)	transmitted due to errors.					

4 Ethernet performance analysis

4.1 CPU utilization vs network load

To estimate the effect of network load on CPU utilization and the efficiency of packet processing, perform an analysis on the XSeries^{G5}, µFLO^{G5}, or RMC-100. Different data rates (100 Kbps to 100 Mbps) have been used with different packet rates by using different packet sizes (64, 128, 256, 512, 1024, 1500) to determine the impact of network traffic in various situations.

Parameters Measured:

CPU Utilization - Percentage of CPU utilization

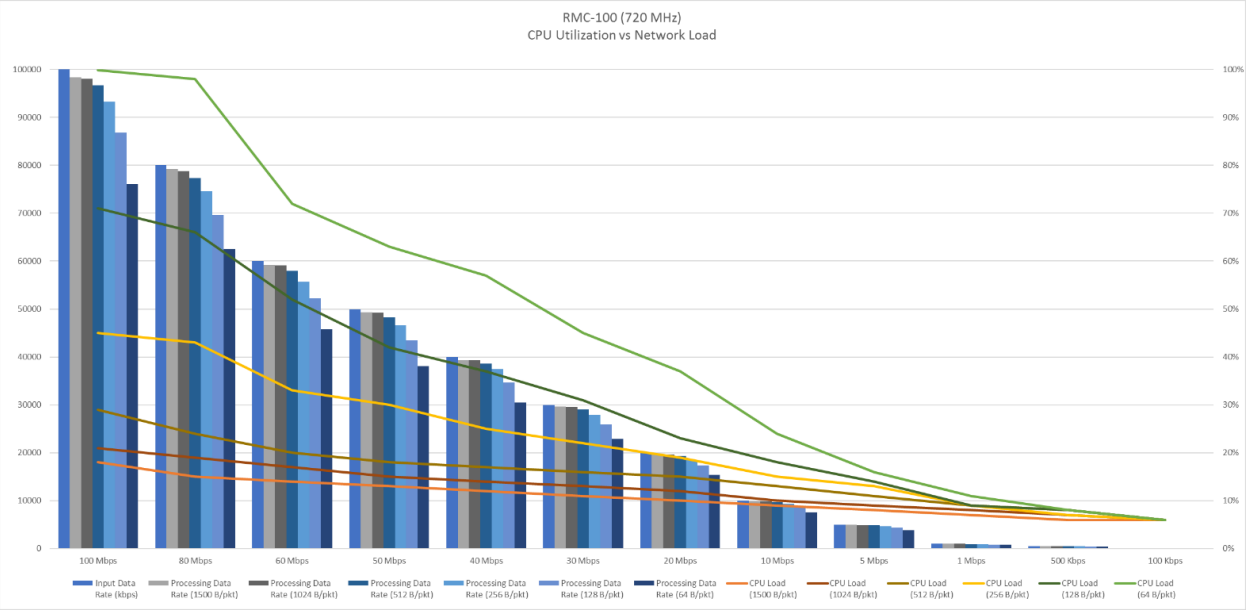
Data Processing Efficiency - Bytes processed / bytes received

Inputs:

Highest Packet Rate at 100 Mbps - 195313 packet/sec (64 Bytes/packet)

Lowest Packet Rate at 100 Mbps - 8333 packet/sec (1500 Bytes/packet)

Figure 4-1: RMC-100 (720 MHz)



5 Recommendations

- Use a few large requests instead of many small requests in MODBUS or SCADA communication.
- Determine the maximum load on the Ethernet in your system and set your data rate limits a little higher than that.

6 Conclusion

Packet rate impacts the CPU load more than the data rate.

For example, at 100 Mbps data rate, a packet rate of 95313 packets/sec (64 Bytes/packet) makes the CPU load go to ~100%, whereas at the same 100 Mbps rate, packet rate of 8333 packets/sec (1500 Bytes/packet) make the CPU load go to only ~18%.

The efficiency of the processing packets is also reduced with a higher packet rate.

For example, at lowest packet rate of 8333 packets/sec at 100 Mbps the efficiency is ~98%, while at highest packet rate of 195313 packets/sec at 100 Mbps the efficiency is only ~76%.

ABB Inc.

Measurement & Analytics

Quotes: totalflow.inquiry@us.abb.com

Orders: totalflow.order@us.abb.com

Training: totalflow.training@us.abb.com

Support: upstream.support@us.abb.com

+1 800 442 3097 (opt. 2)

www.abb.com/upstream

Additional free publications are available for download at:

www.abb.com/totalflow

Or you can find free publications at the code on the right:

Main Office - Bartlesville
7051 Industrial Blvd
Bartlesville, OK 74006
Ph: +1 918 338 4888

Kansas Office - Liberal
2705 Centennial Blvd
Liberal, KS 67901
Ph: +1 620 626 4350

Texas Office – Odessa
8007 East Business 20
Odessa, TX 79765
Ph: +1 432 272 1173

Texas Office - Houston
3700 W. Sam Houston
Parkway S., Suite 600
Houston, TX 77042
Ph: +1 713 587 8000

California Office - Bakersfield
4300 Stine Road
Suite 405-407
Bakersfield, CA 93313
Ph: +1 661 833 2030

Texas Office – Pleasanton
150 Eagle Ford Road
Pleasanton, TX 78064
Ph: +1 830 569 8062

2105999MNAA