



RTM64: SFP+ and QSFP+ Network Module

INTRODUCTION

The Rear Transition Module (RTM) is an external peripheral board that connects to the BEE7 over the Zone-3 connector. In particular, this interface is connected to the FPGA's GTHs. The RTMs provided by BEEcube are intended to provide high-density, high throughput network interfaces.

The RTM64 contains 16 SFP+ ports that support up to 10Gbps per port and 12 QSFP+ ports that support up to 40Gbps per port. Therefore the aggregate throughput through of the RTM64 is 640Gbps, or 160Gbps per FPGA.

The RTM ports are mapped to BPSv45 design software according to the diagram below.

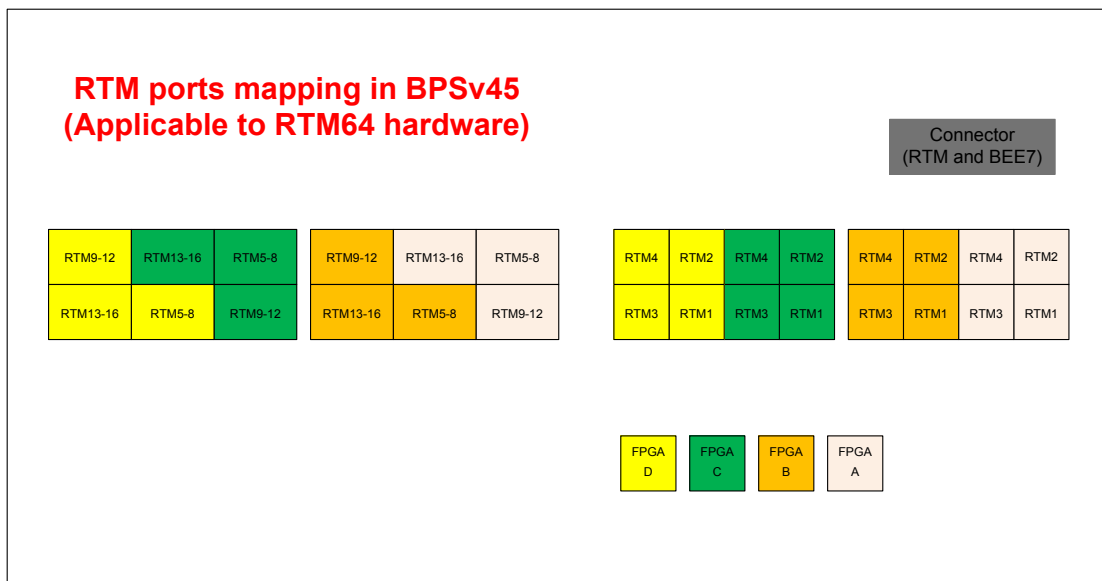


Figure 1: RTM64 physical mapping

If the RTM64 is installed in a 2-slot ATCA chassis and oriented horizontally, the Zone-3 connector is located on the left side of the BEE7 blade if you are facing the

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front panel of the BEE7. If you are looking from behind the chassis, the Zone-3 connector is located on the right side of the BEE7 blade. If the RTM64 is installed in a 14-slot ATCA chassis and oriented vertically, the Zone-3 connector is located on the topside of the BEE7 blade.

SPECIFICATIONS

General

- Recommended short-range optical SFP+ module: Innolight TR-PX85S-N00
- Recommended long-range SFP+ module: TBD
- Recommended short-range optical QSFP+ module: FCI ICD040GVP163D-10
- Recommended long-range QSFP+ module: TBD

Mechanical

- The RTM64 occupies two-slot height

RTM Repeater Information

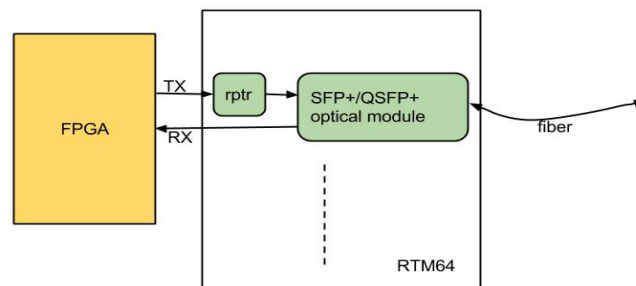


Figure 2: RTM64 signal path (TX/RX)

Trace repeaters are included to optimize the BER performance across the ports on RTM64. These repeaters affect the TX channels originating from the FPGA GTH to the SFP+ or QSFP+ optical transceiver module as shown in Figure 2. Based on the optical transceiver module used, repeaters' tuning parameters will vary. The tuning parameters include *output voltage level*, *output de-emphasis level*, and *receiver equalization level*. BEEcube provides firmware to users when parameter tuning is needed:

rtm64control rprr [options]

- f Tune repeaters for given FPGAs (*A B C D*). Can be a list (e.g. *ABC*). Defaults to all FPGAs.
- l Tune repeater settings for selected lanes. Argument is a mask of the lanes to tune or read back (e.g. *0x8f* to change lanes 0-3 and 7). This lane number is indexed starting at zero, which corresponds to one less than the aforementioned BPSv45 RTM port mappings (e.g. RTM1 = lane 0).

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- v Set the differential output voltage level (0x0 – 0x7) from 0.7V to 1.4V.
- d Set the output de-emphasis level (0x0 – 0x7) from 0dB to -12dB.
- e Set the receiver equalization level (0x0 – 0xFF).
- r Tuning read-back of selected lanes.
- o Override default pin control functionality.

Based on extensive testing with a variety of QSFP+ and SFP+ optical transceiver modules, the recommended tuning values are:

- Recommended repeater receiver equalization: 0x00 to 0x03
- Recommended repeater output de-emphasis: 0x0 to 0x3
- Recommended repeater output voltage: 0x1 to 0x4

EQ – 8 bits [7:0]	dB at 1.5 GHz	dB at 2.5 GHz	dB at 4 GHz	dB at 6 GHz	VOD Vp-p	DEM dB ⁽¹⁾	Inner Amplitude Vp-p
0000 0000 = 0x00	2.5	3.5	3.8	3.1	0.8	0	0.8
0000 0001 = 0x01	3.8	5.4	6.7	6.7	0.9	0	0.9
0000 0010 = 0x02	5.0	7.0	8.4	8.4	0.9	- 3.5	0.6
0000 0011 = 0x03	5.9	8.0	9.3	9.1	1.0	0	1.0
0000 0111 = 0x07	7.4	10.3	12.8	13.7	1.0	- 3.5	0.7
0001 0101 = 0x15	6.9	10.2	13.9	16.2	1.0	- 6	0.5
0000 1011 = 0x0B	9.0	12.4	15.3	15.9	1.1	0	1.1
0000 1111 = 0x0F	10.2	13.8	16.7	17.0	1.1	- 3.5	0.7
0101 0101 = 0x55	8.5	12.6	17.5	20.7	1.1	- 6	0.6
0001 1111 = 0x1F	11.7	16.2	20.3	21.8	1.2	0	1.2
0010 1111 = 0x2F	13.2	18.3	22.8	23.6	1.2	- 3.5	0.8
0011 1111 = 0x3F	14.4	19.8	24.2	24.7	1.2	- 6	0.6
1010 1010 = 0xAA	14.4	20.5	26.4	28.0	1.3	0	1.3
0111 1111 = 0x7F	16.0	22.2	27.8	29.2	1.3	- 3.5	0.9
1011 1111 = 0xBF	17.6	24.4	30.2	30.9	1.3	- 6	0.7
1111 1111 = 0xFF	18.7	25.8	31.6	31.9	1.3	- 9	0.5

Receiver equalization

Differential output voltage and output de-emphasis

Figure 3: RTM64 Repeater tuning parameters

More information of the repeater chip used on RTM64 is available from the vendor's website: <http://www.ti.com/lit/ds/symlink/ds125br800.pdf>.

FPGA GTH Information

If BEEcube provided IPs are used to target the GTHs connected to RTM ports, the detailed physical information of the GTHs and their associated reference clock input will be transparent to the users. BEEcube provides design software, BEEcube Platform Studio (BPS), so users can simply specify which port (as shown in the column of “port number”) they want the IP to use.

If the user wants to design their own IPs using GTHs connected with RTM ports, they will need to use the physical information summarized in the tables below.

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Table 1: GTHs mapping to RTM40 ports

GTH Bank	Port Number (BPS mapping)	FPGA GTH Location	GTH device pin (txp/txn, rxp/rxn)	RTM64 port
112	1	X1Y8	AR2/AR1, AN6/AN5	SFP+
	2	X1Y9	AP4/AP3, AM4/AM3	SFP+
	3	X1Y10	AN2/AN1, AM8/AM7	SFP+
	4	X1Y11	AL2/AL1, AL6/AL5	SFP+
113	5	X1Y12	AK4/AK3, AK8/AK7	QSFP+
	6	X1Y13	AJ2/AJ1, AJ6/AJ5	QSFP+
	7	X1Y14	AH4/AH3, AG6/AG5	QSFP+
	8	X1Y15	AG2/AG1, AE6/AE5	QSFP+
114	9	X1Y16	AF4/AF3, AD8/AD7	QSFP+
	10	X1Y17	AE2/AE1, AC6/AC5	QSFP+
	11	X1Y18	AE4/AD3, AA6/AA5	QSFP+
	12	X1Y19	AC2/AC1, Y8/Y7	QSFP+
115	13	X1Y20	AB4/AB3, W6/W5	QSFP+
	14	X1Y21	AA2/AA1, V8/V7	QSFP+
	15	X1Y22	Y4/Y3, U6/U5	QSFP+
	16	X1Y23	W2/W1, T8/T7	QSFP+

Table 2: Reference clocks for GTH mapped to RTM

GTH Bank	MGTREFCLK0		MGTREFCLK1	
	Package pin	Connectivity	Package pin	Connectivity
112	AL10, AL9	Reference clock RTM0 (build option. E.g., 307.2MHz)	AN10, AN9	GTH SMA (user input)
113	AF8, AF7	Reference clock RTM 1 (build option)	AH8, AH7	BEE7 global GTH reference clock (312.5MHz)
114	AA10, AA9	RTM0	AB8, AB7	Jitter cleaner output
115	U10, U9	RTM1	W10, W9	GTH SMA (user input)

The RTM0 and RTM1 reference clocks are sourced from crystals on the RTM module. Both crystals are build options upon customer's request.

APPLICATION

- 10 GbE network interface
- CPRI interface

CONTACT

Please visit our website (www.beecube.com) or send email to support@beecube.com for more information.