![RAMTRON International Corporation]

Foundry Transfer | November 19th 2010

F-RAM Foundry/Technology Partners

	Foundry		Geometry
Yesterday	**FUJITSU** (Exiting 2009)	Licensee	0.5µ 0.35µ
Today	**TEXAS INSTRUMENTS**	Licensee	0.13µ
Tomorrow	**TEXAS INSTRUMENTS**	Licensee	0.13µ
	IBM	Pure Play Ramtron Line	0.18µ

Transfer Background

- Robust demand for Ramtron memory products has stressed the supply of our remaining Fujitsu inventory ahead of our planned IBM foundry transition timeline

- Ramtron has made good progress in establishing the IBM line but more time is needed to meet Ramtron's quality and reliability guidelines

Transfer Status

- As a solution, Ramtron has developed an alternative source of products that can replace the Fujitsu-sourced parts until the IBM manufacturing line is ready for production

  - Original part number will be amended with a "B"

  - 64Kb and 256Kb densities will have a "W" option (wide operating voltage)

  - Based on proven F-RAM technology from the Ramtron's TI-based manufacturing line

Transfer Strategy

Fujitsu manufactured Parts

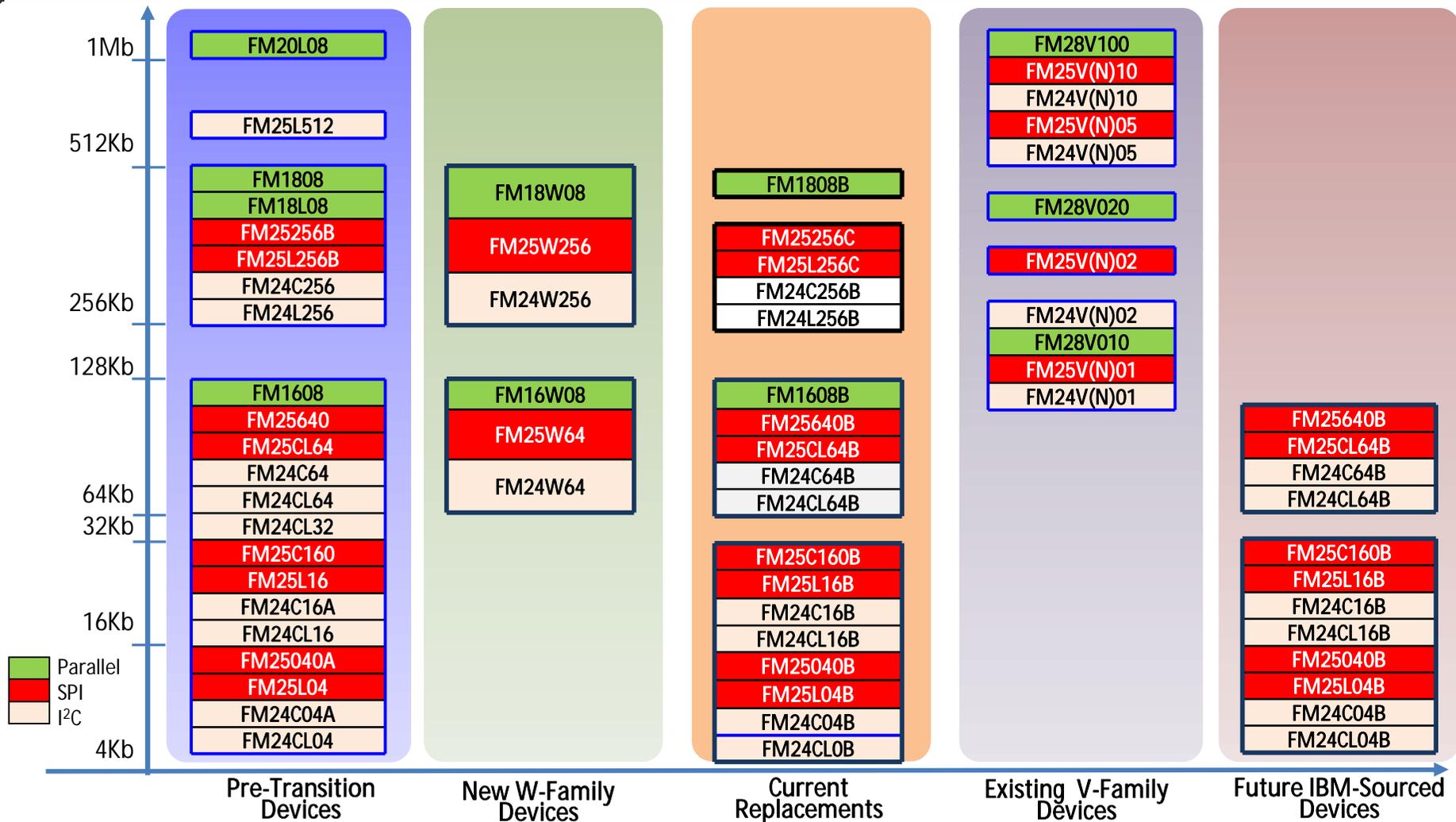Now

Once qualified

W and B Parts based on TI F-RAM

B Parts manufactured at IBM

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Foundry Transfer Part Cross Reference Table

	Pre-Transition Devices	New W-Family Devices	Current Replacements	Existing V-Family Devices	Future IBM-Sourced Devices
1Mb	FM20L08			FM28V100 / FM25V(N)10 / FM24V(N)10 / FM25V(N)05 / FM24V(N)05	
512Kb	FM25L512				
	FM1808 / FM18L08 / FM25256B / FM25L256B / FM24C256 / FM24L256	FM18W08 / FM25W256 / FM24W256	FM1808B / FM25256C / FM25L256C / FM24C256B / FM24L256B	FM28V020 / FM25V(N)02 / FM24V(N)02 / FM28V010 / FM25V(N)01 / FM24V(N)01	
256Kb					
128Kb					
	FM1608 / FM25640 / FM25CL64 / FM24C64 / FM24CL64 / FM24CL32	FM16W08 / FM25W64 / FM24W64	FM1608B / FM25640B / FM25CL64B / FM24C64B / FM24CL64B		FM25640B / FM25CL64B / FM24C64B / FM24CL64B
64Kb					
32Kb					
	FM25C160 / FM25L16 / FM24C16A / FM24CL16 / FM25040A / FM25L04 / FM24C04A / FM24CL04		FM25C160B / FM25L16B / FM24C16B / FM24CL16B / FM25040B / FM25L04B / FM24C04B / FM24CL0B		FM25C160B / FM25L16B / FM24C16B / FM24CL16B / FM25040B / FM25L04B / FM24C04B / FM24CL04B
16Kb					
4Kb					

Legend: **Parallel** (green), **SPI** (red), **I²C** (cream)

IBM Foundry Status

- Silicon is in the line but quality, reliability and yield must be established

- The silicon in the line has enabled us to establish preliminary specifications

  – There are some changes to the specifications from the Fujitsu sourced parts

FM24C16B

Symbol	Parameter	FM24C16A	FM24C16B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	4.5 – 5.5	4.5 – 5.5	V	
I_{DD}	V_{DD} Supply Current				
	@ SCL = 100 kHz	150	100	µA	
	@ SCL = 400 kHz	500	200	µA	
	@ SCL = 1 MHz	1000	400	µA	
I_{SB}	Standby Current				
	@ V_{DD} = 5.5V	10	10	µA	
Tlead	Lead Temp	300	260	ºC	
HBM	Human Body Model ESD	4kV	TBD	V	
CDM	Charged Device Model ESD	1kV	TBD	V	
MM	Machine Model ESD	300V	TBD	V	
Endurance	Endurance cycles	1E12	1E12	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
R_{IN}	Address Input Resistance (WP, A2-A0) For $V_{IN} = V_{IL}$ For $V_{IN} = V_{IH}$	50 1	40 1	KΩ MΩ	Min Min

FM24CL16B

Symbol	Parameter	FM24CL16	FM24CL16B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	2.7 – 3.65	2.7 – 3.65	V	
I_{DD}	V_{DD} Supply Current @ SCL = 100 kHz @ SCL = 400 kHz @ SCL = 1 MHz	 75 200 450	 100 170 300	 µA µA µA	
I_{SB}	Standby Current @ V_{DD} = 3.65V	 1	 6	 µA	
Tlead	Lead Temp	300	260	ºC	
V_{ESD}	Human Body Model ESD	4kV	TBD	V	
V_{ESD}	Charged Device Model ESD	-	TBD	V	
V_{ESD}	Machine Model ESD	300V	TBD	V	
Endurance	Endurance cycles	Unlimited	1E14	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
R_{IN}	Address Input Resistance (WP, A2-A0) For $V_{IN} = V_{IL}$ For $V_{IN} = V_{IH}$	 50 1	 40 1	 KΩ MΩ	 Min Min

FM24C04B

Symbol	Parameter	FM24C04A	FM24C04B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	4.5 – 5.5	4.5 – 5.5	V	
I_{DD}	V_{DD} Supply Current				
	@ SCL = 100 kHz	150	100	μA	
	@ SCL = 400 kHz	500	200	μA	
	@ SCL = 1 MHz	1000	400	μA	
I_{SB}	Standby Current				
	@ V_{DD} = 5.5V	10	10	μA	
Tlead	Lead Temp	300	260	°C	
V_{ESD}	Human Body Model ESD	3kV	TBD	V	
V_{ESD}	Charged Device Model ESD	-	TBD	V	
V_{ESD}	Machine Model ESD	300V	TBD	V	
Endurance	Endurance cycles	1E12	1E12	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
R_{IN}	Address Input Resistance (WP, A2-A0) For V_{IN} = V_{IL} For V_{IN} = V_{IH}	50 1	40 1	KΩ MΩ	Min Min

Symbol	Parameter	FM24CL04	FM24CL04B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	2.7 – 3.65	2.7 – 3.65	V	

I_{DD}	V_{DD} Supply Current
	  @ SCL = 100 kHz
	  @ SCL = 400 kHz
	  @ SCL = 1 MHz
		
		75
		150
		300
			
			100
			170
			300
				
				µA
				µA
				µA	

I_{SB}	Standby Current @ V_{DD} = 3.65V	 1	 6	 µA	
Tlead	Lead Temp	300	260	°C	
V_{ESD}	Human Body Model ESD	3kV	TBD	V	
V_{ESD}	Charged Device Model ESD	-	TBD	V	
V_{ESD}	Machine Model ESD	300V	TBD	V	
Endurance	Endurance cycles	Unlimited	1E14	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
R_{IN}	Address Input Resistance (WP, A2-A0) For V_{IN} = V_{IL} For V_{IN} = V_{IH}	 50 1	 40 1	 KΩ MΩ	 Min Min

FM25C160B

Symbol	Parameter	FM25C160	FM25C160B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	4.5 – 5.5	4.5 – 5.5	V	
fCK max	Maximum Frequency	20.0	20.0	MHz	
I_{DD}	V_{DD} Supply Current @ SCK = 1.0 MHz @ SCK = fCK max	0.40 8.00	0.25 4.00	mA mA	
I_{SB}	Standby Current @ V_{DD} = 5.5V	10	10	µA	
Tlead	Lead Temp	300	260	ºC	
V_{ESD}	Human Body Model ESD	4kV	TBD	V	
V_{ESD}	Charged Device Model ESD	1kV	TBD	V	
V_{ESD}	Machine Model ESD	400V	TBD	V	
Endurance	Endurance cycles	1E12	1E12	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
tR max	Data in Rise Time	50	50	ns	
tF max	Data in Fall Time	50	50	ns	

FM25L16B

Symbol	Parameter	FM25L16	FM25L16B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	2.7 – 3.6	2.7 – 3.6	V	
fCK max	Maximum Frequency	18.0	20.0	MHz	
I_{DD}	V_{DD} Supply Current @ SCK = 1.0 MHz @ SCK = fCK max	0.30 5.50	0.20 3.00	mA mA	
I_{SB}	Standby Current @ V_{DD} = 3.6V	1	6	μA	
Tlead	Lead Temp	300	260	ºC	
V_{ESD}	Human Body Model ESD	4kV	TBD	V	
V_{ESD}	Charged Device Model ESD	1kV	TBD	V	
V_{ESD}	Machine Model ESD	-	TBD	V	
Endurance	Endurance cycles	Unlimited	1E14	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
tR max	Data in Rise Time	50	50	ns	
tF max	Data in Fall Time	50	50	ns	

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FM25040B

Symbol	Parameter	FM25040A	FM25040B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	4.5 – 5.5	4.5 – 5.5	V	
fCK max	Maximum Frequency	20.0	20.0	MHz	

I_{DD}	V_{DD} Supply Current
	  @ SCK = 1.0 MHz
	  @ SCK = fCK max
		
		0.40
		8.00
			
			0.25
			4.00
				
				mA
				mA	

I_{SB}	Standby Current @ V_{DD} = 5.5V	 10	 10	 μA	
Tlead	Lead Temp	300	260	ºC	
V_{ESD}	Human Body Model ESD	4kV	TBD	V	
V_{ESD}	Charged Device Model ESD	1kV	TBD	V	
V_{ESD}	Machine Model ESD	400V	TBD	V	
Endurance	Endurance cycles	1E12	1E12	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
tR max	Data in Rise Time	50	50	ns	
tF max	Data in Fall Time	50	50	ns	

FM25L04B

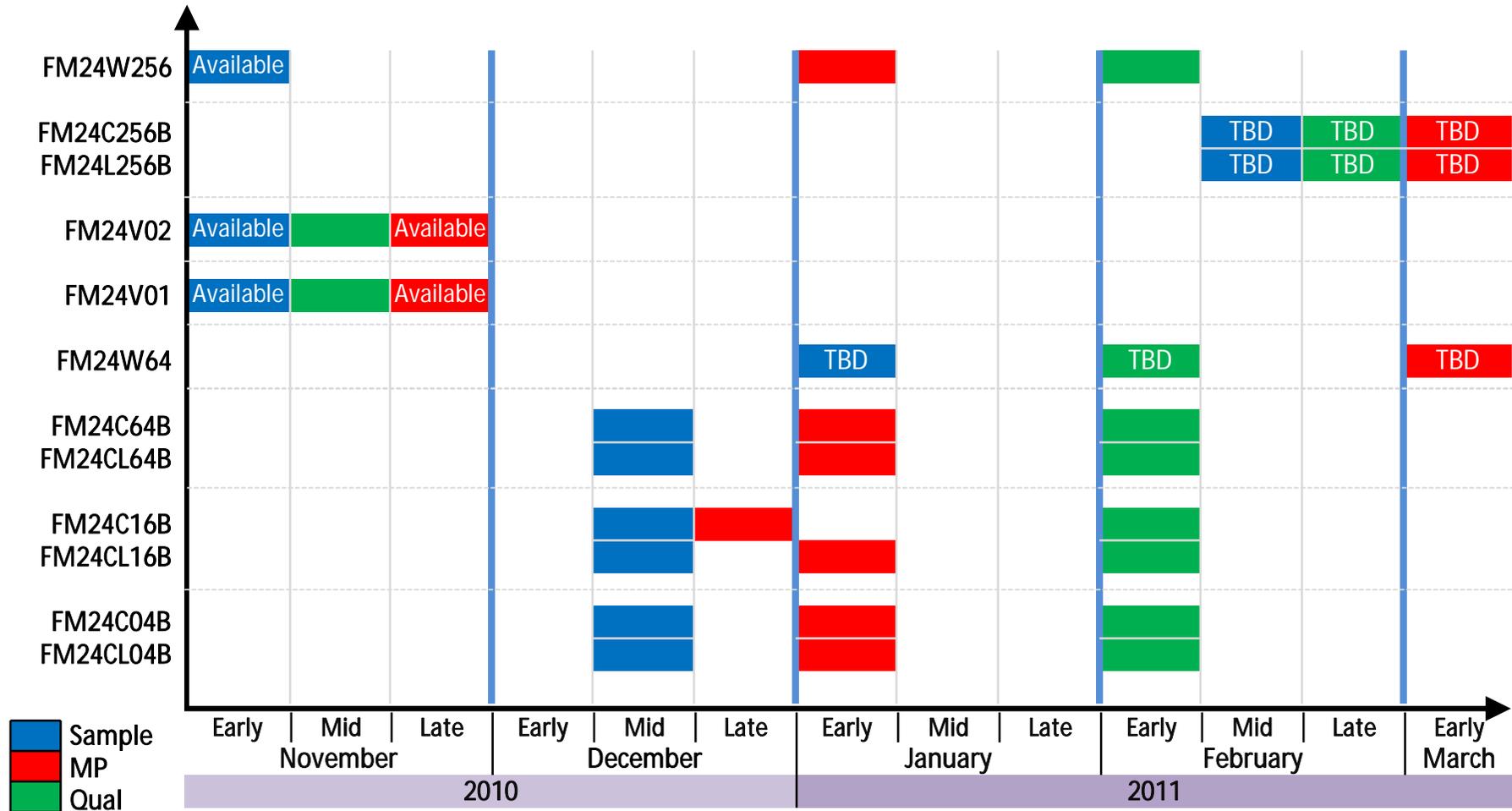| Symbol	Parameter	FM25L04	FM25L04B (Preliminary)	Units	Notes
V_{DD}	Main Power Supply	2.7 – 3.6	2.7 – 3.6	V	
fCK max	Maximum Frequency	14.0	20.0	MHz	
I_{DD}	V_{DD} Supply Current @ SCK = 1.0 MHz @ SCK = fCK max	0.17 3.00	0.20 3.00	mA mA	
I_{SB}	Standby Current @ V_{DD} = 3.6V	1	6	μA	
Tlead	Lead Temp	300	260	°C	
V_{ESD}	Human Body Model ESD	4kV	TBD	V	
V_{ESD}	Charged Device Model ESD	1kV	TBD	V	
V_{ESD}	Machine Model ESD	400V	TBD	V	
Endurance	Endurance cycles	Unlimited	1E14	Cycles	
Retention	Retention	45	10 19 38	Years	Table will show 85C 80C 75C values
tR max	Data in Rise Time	50	50	ns	
tF max	Data in Fall Time	50	50	ns	

Schedules

- "B" and "W" silicon has started sampling

- Additional parts will sample over the coming weeks

- Production quantities will ship in Q1 (targeting late Q4)

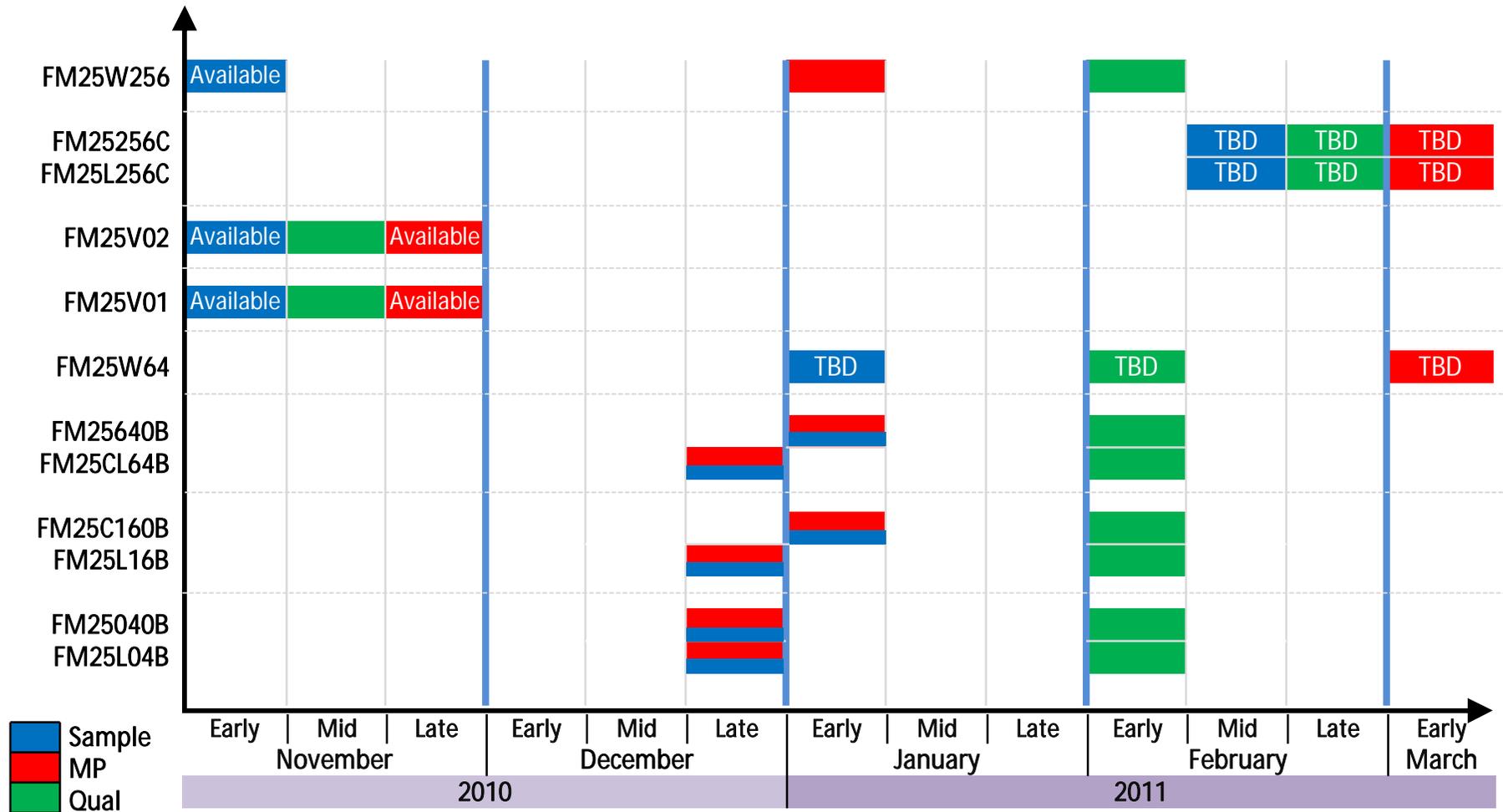- Qual reports will start becoming available in February 2011
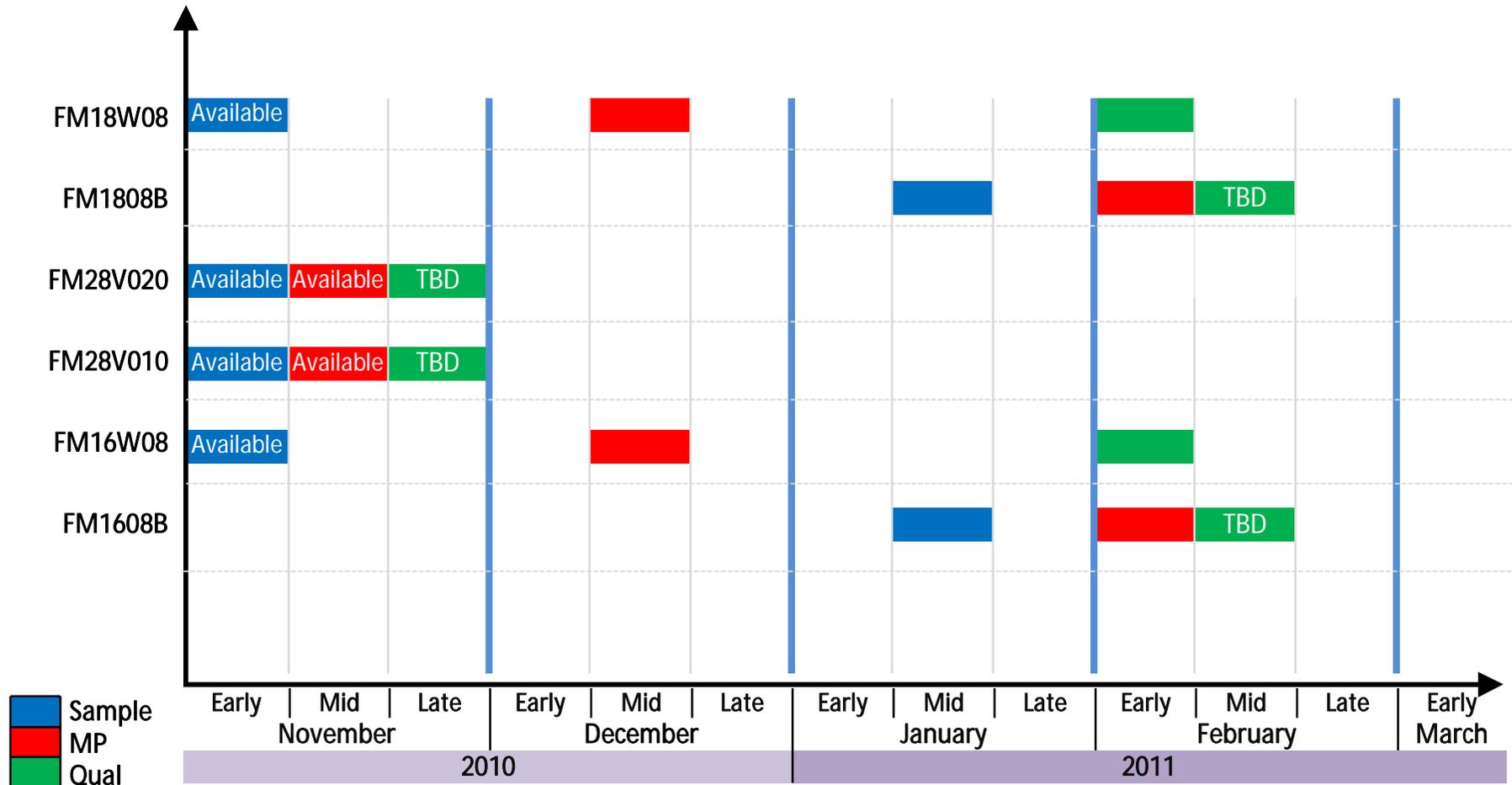
I²C Part Schedule

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SPI Part Schedule

Legend:
- Sample (blue)
- MP (red)
- Qual (green)

Timeline:

Part	November (Early/Mid/Late)	December (Early/Mid/Late)	January (Early/Mid/Late)	February (Early/Mid/Late)	March (Early)
FM25W256	Available		TBD	Qual	
FM25256C				TBD / TBD	TBD
FM25L256C				TBD / TBD	TBD
FM25V02	Available / Qual / Available				
FM25V01	Available / Qual / Available				
FM25W64			TBD	TBD	TBD
FM25640B / FM25CL64B					
FM25C160B / FM25L16B					
FM25040B / FM25L04B					

2010 — 2011

Parallel Part Schedule

FAQs

1. Why are the part numbers different to FJ's – Why put "B" at the suffix?

"B" devices are new parts. Several specification changes include higher standby current ,power up to first access time, and additional Vdd ramp specifications added.

2. If there are two or more options: e.g. FM25CL64B, FM25640B, FM25W64? Which do you recommend?

Existing 5V: FM25640B

Existing 3V: FM25CL64B

New 5V Designs: Your choice, FM25640B or FM25W64

New 3V Designs: Your choice, FM25W64 or FM25CL64B

FAQs (Cont'd)

3. What are the major technical differences between the "B"s and "W"s?

	Bs	Ws
Operating Voltage	2.7 – 3.6V or 4.5 – 5.5V	2.7 – 5.5V
Brownout Voltage	~2.5V (3v version) or ~4V (5v version)	~2.5V
I/O Voltage	CMOS except TTL for 5V Parallel	CMOS

4. Do we need PCNs for the new "B"s and "W"s?

No, PCNs not needed for new parts

4. Will the pricing for "B"s the same as the FJ parts?

Yes

5. When can we expect the "B", "W" parts? – realistic, not optimistic, dates. Date to ship 50 customers WW. 10K pcs.

See slide 17 – 19

6. Do we keep the suffix "B" when IBM monolithic parts are ready?

Yes. "B" will stay with the future IBM devices

7. Are we going to make "W" at IBM?

There is no current plan to do so

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