BJT SPICE Model

- BJT is included in the circuit using the line:

QXXX NC NB NE <NS> MNAME <AREA> <OFF> <IC=VBE,VCE>

where: XXX = transistor number
NC, NB, NE, NS = collector, base, emitter, and (optional) substrate nodes
MNAME = model name
AREA = (optional) number of parallel devices of the specified model name
OFF = (optional) initial condition for DC analysis
IC=VBE,VCE = (optional) user-specified conditions for transient analysis

BJT SPICE Model

- Transistor model requires a .MODEL statement:

.MODEL MNAME TYPE(PNAME1=PVAL1 PNAME2=PVAL2 ...)

where: TYPE is NPN or PNP
PNAME1 = is model parameter 1, with value PVAL1, etc.

- *Example*:

.MODEL MODQN NPN IS=1E-17 BF=100 VAF=25 TF = 50P
+ CJE=8E-15 VJE=0.95 MJE=0.5

- Depletion capacitances generally modeled as:

$$C_{\mu} = \frac{CJC}{\left(1 - \frac{VBC}{VJC}\right)^{MJC}}$$

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Common SPICE BJT 1st Order Model Parameters:

Parameter	SPICE name	Units
Transport saturation current (I_S)	IS	A
Ideal maximum forward bias beta (β_F)	BF	-
Forward Early voltage (V_A)	VAF	V
Ideal maximum forward bias beta (β_R)	BR	-
Base resistance (r_b)	RB	Ω
Emitter resistance (r_{ex})	RE	Ω
Collector resistance (r_c)	RC	Ω
B-E zero-bias depletion capacitance (C_{jE0})	CJE	F
B-E built-in potential (ϕ_{BE})	VJE	V

Parameter	SPICE name	Units
B-E junction exponential factor	MJE	-
B-C zero-bias depletion capacitance ($C_{j\mu 0}$)	CJC	F
B-C built-in potential (ϕ_{BC})	VJC	V
B-C junction exponential factor	MJC	-
Substrate zero-bias depletion capacitance (C_{CS0})	CJS	F
Substrate built-in potential (ϕ_{BS})	VJS	V
Substrate junction exponential factor	MJS	-
Ideal forward transit time (τ_F)	TF	seconds