

**DUAL J-K FLIP-FLOP** **MTTL III MC3100/3000 series**

**MC3161F • MC3061F**  
**MC3161L • MC3061L,P**

This dual JK flip-flop triggers on the negative edge of clock. Each flip-flop is provided with a separate direct SET input in addition to the common direct RESET input. These direct inputs provide a means of resetting a group of flip-flops such as a register which may be followed by the presetting of a data pattern. The clock input for this device is common for both flip-flops, making it particularly useful in registers or other common clock applications.

Data may be applied to or changed at the clocked inputs at any time during the clock cycle, except during the time interval between

the Setup and Hold times. The inputs are inhibited when the clock is low and enabled when the clock rises. The input steering network continuously responds to input information when the clock is high. The data state at the inputs throughout the interval between the Setup and Hold time is stored in the flip-flop when the clock falls. Each flip-flop may be set at any time without regard to the clock state by applying a low level to the SET input. In addition, both flip-flops may be reset simultaneously by using the common RESET in a similar manner.

**LOGIC DIAGRAM**

1/2 OF DEVICE SHOWN,  
RESET AND CLOCK COMMON TO BOTH

Input Loading Factors:  
SET = 1.75  
RESET, CLOCK = 3.7  
J, K = 0.75

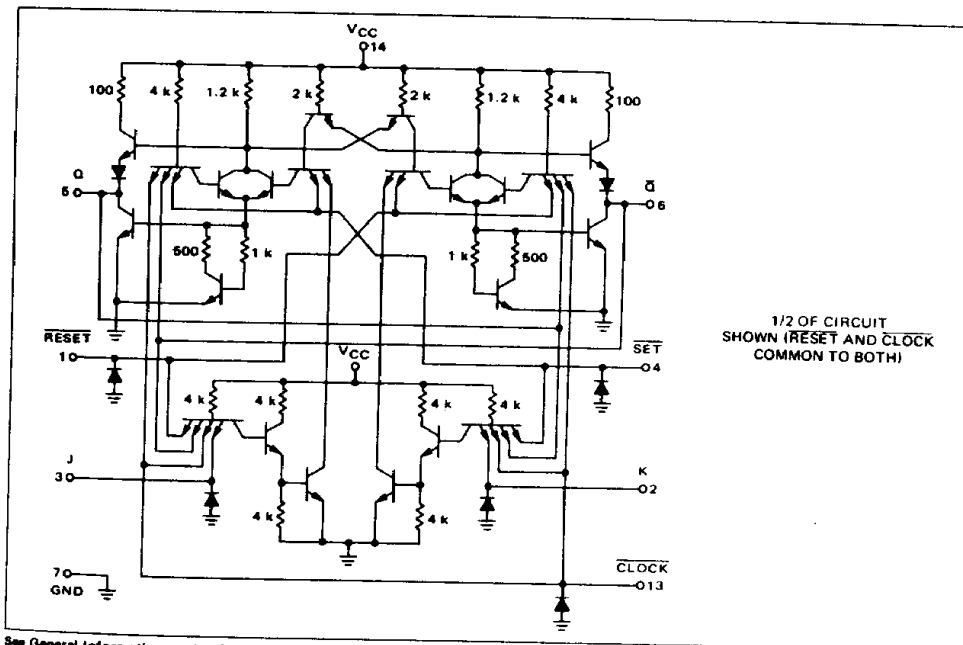
Output Loading Factor = 10

**J-K TRUTH TABLE**

J	K	Q <sup>n</sup>	Q <sup>n+1</sup>
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Typical Characteristics  
(V<sub>CC</sub> = 5.0 V, T<sub>A</sub> = 25°C)

Total Power Dissipation = 100 mW/pkg  
Toggle Frequency = 50 MHz typ  
Logical "1" Setup Time = 8.0 ns  
Logical "0" Setup Time = 8.0 ns  
Logical "1" and "0" Hold Times = 0 ns  
t<sub>pd-</sub> = 12 ns  
t<sub>pd+</sub> = 12 ns



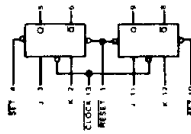
See General information section for packaging.

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MC3161F, MC3061F/MC3161L, MC3061L,P (continued)

ELECTRICAL CHARACTERISTICS

Test procedures are shown for only one flip-flop plus the inputs common to both flip-flops. To complete testing, sequence through the remaining inputs in the same manner.



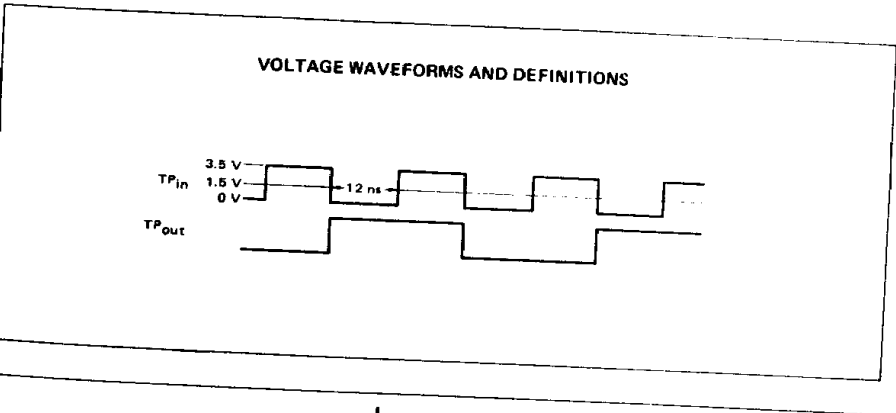
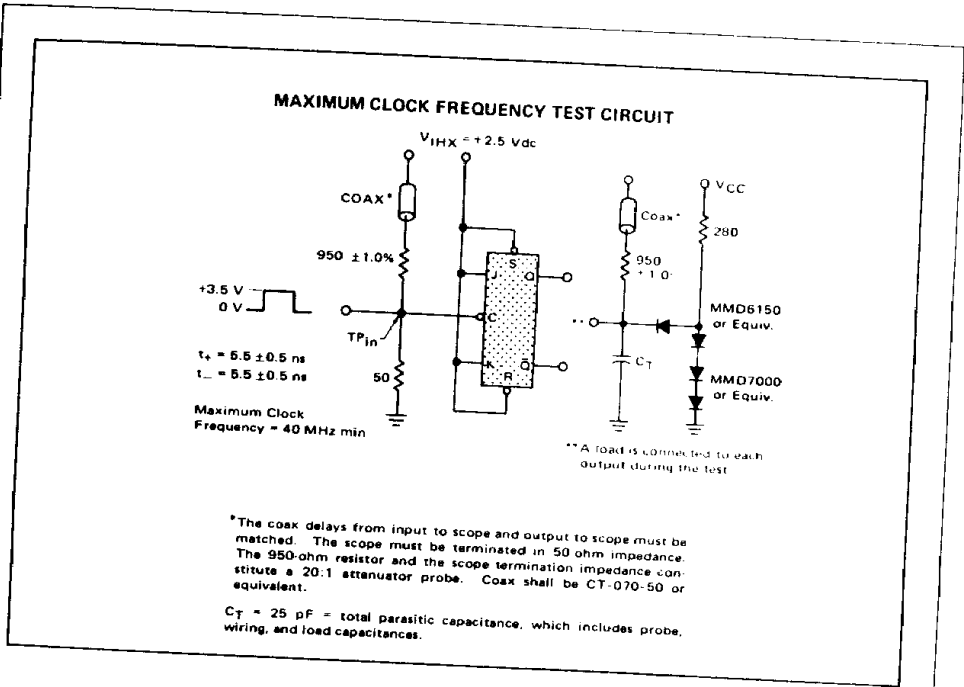
Characteristic	Symbol	Pin Under Test	TEST CURRENT/VOLTAGE VALUES												V <sub>OH</sub>	V <sub>OL</sub>	V <sub>max</sub>	V <sub>CC</sub>	V <sub>CC1</sub>	V <sub>CC2</sub>	V <sub>CC3</sub>	V <sub>CC4</sub>	V <sub>CC5</sub>	V <sub>CC6</sub>	V <sub>CC7</sub>	V <sub>CC8</sub>	V <sub>CC9</sub>	V <sub>CC10</sub>	V <sub>CC11</sub>	V <sub>CC12</sub>	V <sub>CC13</sub>	V <sub>CC14</sub>	V <sub>CC15</sub>	V <sub>CC16</sub>	V <sub>CC17</sub>	V <sub>CC18</sub>	V <sub>CC19</sub>	V <sub>CC20</sub>	V <sub>CC21</sub>	V <sub>CC22</sub>	V <sub>CC23</sub>	V <sub>CC24</sub>	V <sub>CC25</sub>	V <sub>CC26</sub>	V <sub>CC27</sub>	V <sub>CC28</sub>	V <sub>CC29</sub>	V <sub>CC30</sub>	V <sub>CC31</sub>	V <sub>CC32</sub>	V <sub>CC33</sub>	V <sub>CC34</sub>	V <sub>CC35</sub>	V <sub>CC36</sub>	V <sub>CC37</sub>	V <sub>CC38</sub>	V <sub>CC39</sub>	V <sub>CC40</sub>	V <sub>CC41</sub>	V <sub>CC42</sub>	V <sub>CC43</sub>	V <sub>CC44</sub>	V <sub>CC45</sub>	V <sub>CC46</sub>	V <sub>CC47</sub>	V <sub>CC48</sub>	V <sub>CC49</sub>	V <sub>CC50</sub>	V <sub>CC51</sub>	V <sub>CC52</sub>	V <sub>CC53</sub>	V <sub>CC54</sub>	V <sub>CC55</sub>	V <sub>CC56</sub>	V <sub>CC57</sub>	V <sub>CC58</sub>	V <sub>CC59</sub>	V <sub>CC60</sub>	V <sub>CC61</sub>	V <sub>CC62</sub>	V <sub>CC63</sub>	V <sub>CC64</sub>	V <sub>CC65</sub>	V <sub>CC66</sub>	V <sub>CC67</sub>	V <sub>CC68</sub>	V <sub>CC69</sub>	V <sub>CC70</sub>	V <sub>CC71</sub>	V <sub>CC72</sub>	V <sub>CC73</sub>	V <sub>CC74</sub>	V <sub>CC75</sub>	V <sub>CC76</sub>	V <sub>CC77</sub>	V <sub>CC78</sub>	V <sub>CC79</sub>	V <sub>CC80</sub>	V <sub>CC81</sub>	V <sub>CC82</sub>	V <sub>CC83</sub>	V <sub>CC84</sub>	V <sub>CC85</sub>	V <sub>CC86</sub>	V <sub>CC87</sub>	V <sub>CC88</sub>	V <sub>CC89</sub>	V <sub>CC90</sub>	V <sub>CC91</sub>	V <sub>CC92</sub>	V <sub>CC93</sub>	V <sub>CC94</sub>	V <sub>CC95</sub>	V <sub>CC96</sub>	V <sub>CC97</sub>	V <sub>CC98</sub>	V <sub>CC99</sub>	V <sub>CC100</sub>	V <sub>CC101</sub>	V <sub>CC102</sub>	V <sub>CC103</sub>	V <sub>CC104</sub>	V <sub>CC105</sub>	V <sub>CC106</sub>	V <sub>CC107</sub>	V <sub>CC108</sub>	V <sub>CC109</sub>	V <sub>CC110</sub>	V <sub>CC111</sub>	V <sub>CC112</sub>	V <sub>CC113</sub>	V <sub>CC114</sub>	V <sub>CC115</sub>	V <sub>CC116</sub>	V <sub>CC117</sub>	V <sub>CC118</sub>	V <sub>CC119</sub>	V <sub>CC120</sub>	V <sub>CC121</sub>	V <sub>CC122</sub>	V <sub>CC123</sub>	V <sub>CC124</sub>	V <sub>CC125</sub>	V <sub>CC126</sub>	V <sub>CC127</sub>	V <sub>CC128</sub>	V <sub>CC129</sub>	V <sub>CC130</sub>	V <sub>CC131</sub>	V <sub>CC132</sub>	V <sub>CC133</sub>	V <sub>CC134</sub>	V <sub>CC135</sub>	V <sub>CC136</sub>	V <sub>CC137</sub>	V <sub>CC138</sub>	V <sub>CC139</sub>	V <sub>CC140</sub>	V <sub>CC141</sub>	V <sub>CC142</sub>	V <sub>CC143</sub>	V <sub>CC144</sub>	V <sub>CC145</sub>	V <sub>CC146</sub>	V <sub>CC147</sub>	V <sub>CC148</sub>	V <sub>CC149</sub>	V <sub>CC150</sub>	V <sub>CC151</sub>	V <sub>CC152</sub>	V <sub>CC153</sub>	V <sub>CC154</sub>	V <sub>CC155</sub>	V <sub>CC156</sub>	V <sub>CC157</sub>	V <sub>CC158</sub>	V <sub>CC159</sub>	V <sub>CC160</sub>	V <sub>CC161</sub>	V <sub>CC162</sub>	V <sub>CC163</sub>	V <sub>CC164</sub>	V <sub>CC165</sub>	V <sub>CC166</sub>	V <sub>CC167</sub>	V <sub>CC168</sub>	V <sub>CC169</sub>	V <sub>CC170</sub>	V <sub>CC171</sub>	V <sub>CC172</sub>	V <sub>CC173</sub>	V <sub>CC174</sub>	V <sub>CC175</sub>	V <sub>CC176</sub>	V <sub>CC177</sub>	V <sub>CC178</sub>	V <sub>CC179</sub>	V <sub>CC180</sub>	V <sub>CC181</sub>	V <sub>CC182</sub>	V <sub>CC183</sub>	V <sub>CC184</sub>	V <sub>CC185</sub>	V <sub>CC186</sub>	V <sub>CC187</sub>	V <sub>CC188</sub>	V <sub>CC189</sub>	V <sub>CC190</sub>	V <sub>CC191</sub>	V <sub>CC192</sub>	V <sub>CC193</sub>	V <sub>CC194</sub>	V <sub>CC195</sub>	V <sub>CC196</sub>	V <sub>CC197</sub>	V <sub>CC198</sub>	V <sub>CC199</sub>	V <sub>CC200</sub>	V <sub>CC201</sub>	V <sub>CC202</sub>	V <sub>CC203</sub>	V <sub>CC204</sub>	V <sub>CC205</sub>	V <sub>CC206</sub>	V <sub>CC207</sub>	V <sub>CC208</sub>	V <sub>CC209</sub>	V <sub>CC210</sub>	V <sub>CC211</sub>	V <sub>CC212</sub>	V <sub>CC213</sub>	V <sub>CC214</sub>	V <sub>CC215</sub>	V <sub>CC216</sub>	V <sub>CC217</sub>	V <sub>CC218</sub>	V <sub>CC219</sub>	V <sub>CC220</sub>	V <sub>CC221</sub>	V <sub>CC222</sub>	V <sub>CC223</sub>	V <sub>CC224</sub>	V <sub>CC225</sub>	V <sub>CC226</sub>	V <sub>CC227</sub>	V <sub>CC228</sub>	V <sub>CC229</sub>	V <sub>CC230</sub>	V <sub>CC231</sub>	V <sub>CC232</sub>	V <sub>CC233</sub>	V <sub>CC234</sub>	V <sub>CC235</sub>	V <sub>CC236</sub>	V <sub>CC237</sub>	V <sub>CC238</sub>	V <sub>CC239</sub>	V <sub>CC240</sub>	V <sub>CC241</sub>	V <sub>CC242</sub>	V <sub>CC243</sub>	V <sub>CC244</sub>	V <sub>CC245</sub>	V <sub>CC246</sub>	V <sub>CC247</sub>	V <sub>CC248</sub>	V <sub>CC249</sub>	V <sub>CC250</sub>	V <sub>CC251</sub>	V <sub>CC252</sub>	V <sub>CC253</sub>	V <sub>CC254</sub>	V <sub>CC255</sub>	V <sub>CC256</sub>	V <sub>CC257</sub>	V <sub>CC258</sub>	V <sub>CC259</sub>	V <sub>CC260</sub>	V <sub>CC261</sub>	V <sub>CC262</sub>	V <sub>CC263</sub>	V <sub>CC264</sub>	V <sub>CC265</sub>	V <sub>CC266</sub>	V <sub>CC267</sub>	V <sub>CC268</sub>	V <sub>CC269</sub>	V <sub>CC270</sub>	V <sub>CC271</sub>	V <sub>CC272</sub>	V <sub>CC273</sub>	V <sub>CC274</sub>	V <sub>CC275</sub>	V <sub>CC276</sub>	V <sub>CC277</sub>	V <sub>CC278</sub>	V <sub>CC279</sub>	V <sub>CC280</sub>	V <sub>CC281</sub>	V <sub>CC282</sub>	V <sub>CC283</sub>	V <sub>CC284</sub>	V <sub>CC285</sub>	V <sub>CC286</sub>	V <sub>CC287</sub>	V <sub>CC288</sub>	V <sub>CC289</sub>	V <sub>CC290</sub>	V <sub>CC291</sub>	V <sub>CC292</sub>	V <sub>CC293</sub>	V <sub>CC294</sub>	V <sub>CC295</sub>	V <sub>CC296</sub>	V <sub>CC297</sub>	V <sub>CC298</sub>	V <sub>CC299</sub>	V <sub>CC300</sub>	V <sub>CC301</sub>	V <sub>CC302</sub>	V <sub>CC303</sub>	V <sub>CC304</sub>	V <sub>CC305</sub>	V <sub>CC306</sub>	V <sub>CC307</sub>	V <sub>CC308</sub>	V <sub>CC309</sub>	V <sub>CC310</sub>	V <sub>CC311</sub>	V <sub>CC312</sub>	V <sub>CC313</sub>	V <sub>CC314</sub>	V <sub>CC315</sub>	V <sub>CC316</sub>	V <sub>CC317</sub>	V <sub>CC318</sub>	V <sub>CC319</sub>	V <sub>CC320</sub>	V <sub>CC321</sub>	V <sub>CC322</sub>	V <sub>CC323</sub>	V <sub>CC324</sub>	V <sub>CC325</sub>	V <sub>CC326</sub>	V <sub>CC327</sub>	V <sub>CC328</sub>	V <sub>CC329</sub>	V <sub>CC330</sub>	V <sub>CC331</sub>	V <sub>CC332</sub>	V <sub>CC333</sub>	V <sub>CC334</sub>	V <sub>CC335</sub>	V <sub>CC336</sub>	V <sub>CC337</sub>	V <sub>CC338</sub>	V <sub>CC339</sub>	V <sub>CC340</sub>	V <sub>CC341</sub>	V <sub>CC342</sub>	V <sub>CC343</sub>	V <sub>CC344</sub>	V <sub>CC345</sub>	V <sub>CC346</sub>	V <sub>CC347</sub>	V <sub>CC348</sub>	V <sub>CC349</sub>	V <sub>CC350</sub>	V <sub>CC351</sub>	V <sub>CC352</sub>	V <sub>CC353</sub>	V <sub>CC354</sub>	V <sub>CC355</sub>	V <sub>CC356</sub>	V <sub>CC357</sub>	V <sub>CC358</sub>	V <sub>CC359</sub>	V <sub>CC360</sub>	V <sub>CC361</sub>	V <sub>CC362</sub>	V <sub>CC363</sub>	V <sub>CC364</sub>	V <sub>CC365</sub>	V <sub>CC366</sub>	V <sub>CC367</sub>	V <sub>CC368</sub>	V <sub>CC369</sub>	V <sub>CC370</sub>	V <sub>CC371</sub>	V <sub>CC372</sub>	V <sub>CC373</sub>	V <sub>CC374</sub>	V <sub>CC375</sub>	V <sub>CC376</sub>	V <sub>CC377</sub>	V <sub>CC378</sub>	V <sub>CC379</sub>	V <sub>CC380</sub>	V <sub>CC381</sub>	V <sub>CC382</sub>	V <sub>CC383</sub>	V <sub>CC384</sub>	V <sub>CC385</sub>	V <sub>CC386</sub>	V <sub>CC387</sub>	V <sub>CC388</sub>	V <sub>CC389</sub>	V <sub>CC390</sub>	V <sub>CC391</sub>	V <sub>CC392</sub>	V <sub>CC393</sub>	V <sub>CC394</sub>	V <sub>CC395</sub>	V <sub>CC396</sub>	V <sub>CC397</sub>	V <sub>CC398</sub>	V <sub>CC399</sub>	V <sub>CC400</sub>	V <sub>CC401</sub>	V <sub>CC402</sub>	V <sub>CC403</sub>	V <sub>CC404</sub>	V <sub>CC405</sub>	V <sub>CC406</sub>	V <sub>CC407</sub>	V <sub>CC408</sub>	V <sub>CC409</sub>	V <sub>CC410</sub>	V <sub>CC411</sub>	V <sub>CC412</sub>	V <sub>CC413</sub>	V <sub>CC414</sub>	V <sub>CC415</sub>	V <sub>CC416</sub>	V <sub>CC417</sub>	V <sub>CC418</sub>	V <sub>CC419</sub>	V <sub>CC420</sub>	V <sub>CC421</sub>	V <sub>CC422</sub>	V <sub>CC423</sub>	V <sub>CC424</sub>	V <sub>CC425</sub>	V <sub>CC426</sub>	V <sub>CC427</sub>	V <sub>CC428</sub>	V <sub>CC429</sub>	V <sub>CC430</sub>	V <sub>CC431</sub>	V <sub>CC432</sub>	V <sub>CC433</sub>	V <sub>CC434</sub>	V <sub>CC435</sub>	V <sub>CC436</sub>	V <sub>CC437</sub>	V <sub>CC438</sub>	V <sub>CC439</sub>	V <sub>CC440</sub>	V <sub>CC441</sub>	V <sub>CC442</sub>	V <sub>CC443</sub>	V <sub>CC444</sub>	V <sub>CC445</sub>	V <sub>CC446</sub>	V <sub>CC447</sub>	V <sub>CC448</sub>	V <sub>CC449</sub>	V <sub>CC450</sub>	V <sub>CC451</sub>	V <sub>CC452</sub>	V <sub>CC453</sub>	V <sub>CC454</sub>	V <sub>CC455</sub>	V <sub>CC456</sub>	V <sub>CC457</sub>	V <sub>CC458</sub>	V <sub>CC459</sub>	V <sub>CC460</sub>	V <sub>CC461</sub>	V <sub>CC462</sub>	V <sub>CC463</sub>	V <sub>CC464</sub>	V <sub>CC465</sub>	V <sub>CC466</sub>	V <sub>CC467</sub>	V <sub>CC468</sub>	V <sub>CC469</sub>	V <sub>CC470</sub>	V <sub>CC471</sub>	V <sub>CC472</sub>	V <sub>CC473</sub>	V <sub>CC474</sub>	V <sub>CC475</sub>	V <sub>CC476</sub>	V <sub>CC477</sub>	V <sub>CC478</sub>	V <sub>CC479</sub>	V <sub>CC480</sub>	V <sub>CC481</sub>	V <sub>CC482</sub>	V <sub>CC483</sub>	V <sub>CC484</sub>	V <sub>CC485</sub>	V <sub>CC486</sub>	V <sub>CC487</sub>	V <sub>CC488</sub>	V <sub>CC489</sub>	V <sub>CC490</sub>	V <sub>CC491</sub>	V <sub>CC492</sub>	V <sub>CC493</sub>	V <sub>CC494</sub>	V <sub>CC495</sub>	V <sub>CC496</sub>	V <sub>CC497</sub>	V <sub>CC498</sub>	V <sub>CC499</sub>	V <sub>CC500</sub>	V <sub>CC501</sub>	V <sub>CC502</sub>	V <sub>CC503</sub>	V <sub>CC504</sub>	V <sub>CC505</sub>	V <sub>CC506</sub>	V <sub>CC507</sub>	V <sub>CC508</sub>	V <sub>CC509</sub>	V <sub>CC510</sub>	V <sub>CC511</sub>	V <sub>CC512</sub>	V <sub>CC513</sub>	V <sub>CC514</sub>	V <sub>CC515</sub>	V <sub>CC516</sub>	V <sub>CC517</sub>	V <sub>CC518</sub>	V <sub>CC519</sub>	V <sub>CC520</sub>	V <sub>CC521</sub>	V <sub>CC522</sub>	V <sub>CC523</sub>	V <sub>CC524</sub>	V <sub>CC525</sub>	V <sub>CC526</sub>	V <sub>CC527</sub>	V <sub>CC528</sub>	V <sub>CC529</sub>	V <sub>CC530</sub>	V <sub>CC531</sub>	V <sub>CC532</sub>	V <sub>CC533</sub>	V <sub>CC534</sub>	V <sub>CC535</sub>	V <sub>CC536</sub>	V <sub>CC537</sub>	V <sub>CC538</sub>	V <sub>CC539</sub>	V <sub>CC540</sub>	V <sub>CC541</sub>	V <sub>CC542</sub>	V <sub>CC543</sub>	V <sub>CC544</sub>	V <sub>CC545</sub>	V <sub>CC546</sub>	V <sub>CC547</sub>	V <sub>CC548</sub>	V <sub>CC549</sub>	V <sub>CC550</sub>	V <sub>CC551</sub>	V <sub>CC552</sub>	V <sub>CC553</sub>	V <sub>CC554</sub>	V <sub>CC555</sub>	V <sub>CC556</sub>	V <sub>CC557</sub>	V <sub>CC558</sub>	V <sub>CC559</sub>	V <sub>CC560</sub>	V <sub>CC561</sub>	V <sub>CC562</sub>	V <sub>CC563</sub>	V <sub>CC564</sub>	V <sub>CC565</sub>	V <sub>CC566</sub>	V <sub>CC567</sub>	V <sub>CC568</sub>	V <sub>CC569</sub>	V <sub>CC570</sub>	V <sub>CC571</sub>	V <sub>CC572</sub>	V <sub>CC573</sub>	V <sub>CC574</sub>	V <sub>CC575</sub>	V <sub>CC576</sub>	V <sub>CC577</sub>	V <sub>CC578</sub>	V <sub>CC579</sub>	V <sub>CC580</sub>	V <sub>CC581</sub>	V <sub>CC582</sub>	V <sub>CC583</sub>	V <sub>CC584</sub>	V <sub>CC585</sub>	V <sub>CC586</sub>	V <sub>CC587</sub>	V <sub>CC588</sub>	V <sub>CC589</sub>	V <sub>CC590</sub>	V <sub>CC591</sub>	V <sub>CC592</sub>	V<
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MC3161F, MC3061F/MC3161L, MC3061L,P (continued)

OPERATING CHARACTERISTICS

High state data must be present 12 ns prior to the fall of the clock and remain until 0 ns after the clock falls.  
 The direct SET (individual) inputs and RESET (common) inputs may be used at any time without regard to the clock state. The flip-flop is set to the Q = 1 state by applying a low level to the SET input or reset to the Q = 0 state by applying a low level to the RESET input. If these inputs are not used they should be returned to a voltage between 2.0 and 5.5 Vdc.

Negative edge triggering. The input state during the time interval between the Setup and Hold times is stored in the flip-flop when the clock goes low.  
 Unused clocked inputs should be tied to the clock, to the internally connected output, or to a voltage between 2.0 and 5.5 Vdc.



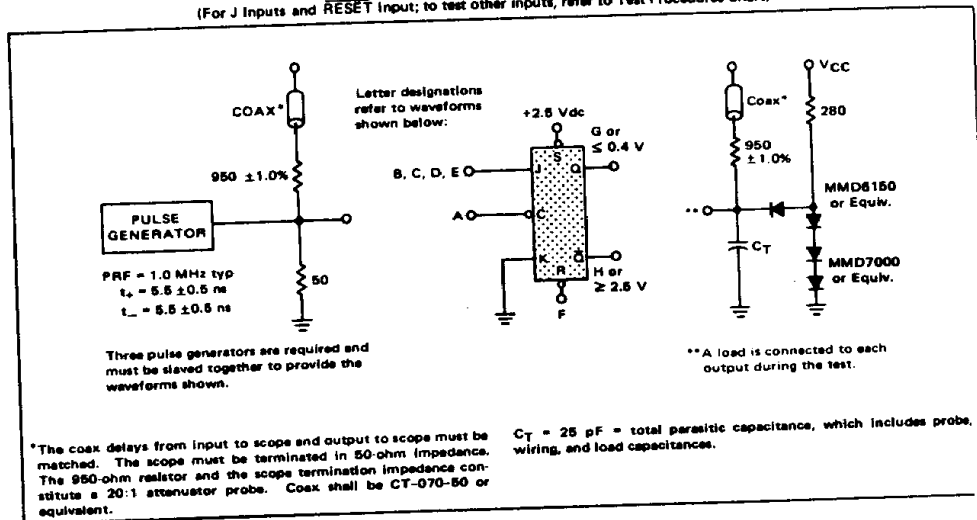
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### MC3161F, MC3061F/MC3161L, MC3061L,P (continued)

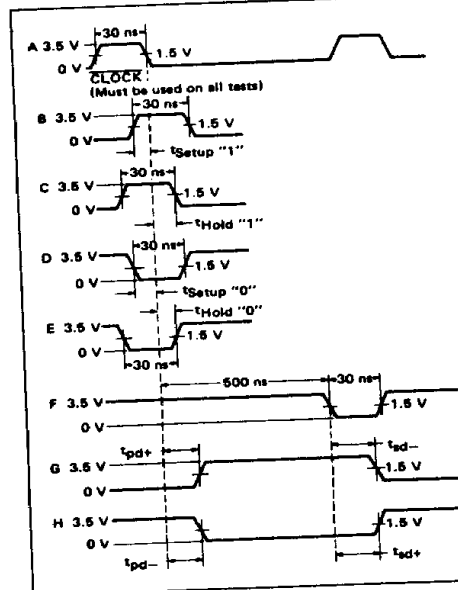
#### OPERATING CHARACTERISTICS (continued)

##### SWITCHING TIME TEST CIRCUIT

(For J Inputs and RESET input; to test other inputs, refer to Test Procedures Chart)



#### VOLTAGE WAVEFORMS AND DEFINITIONS



##### TEST PROCEDURES CHART

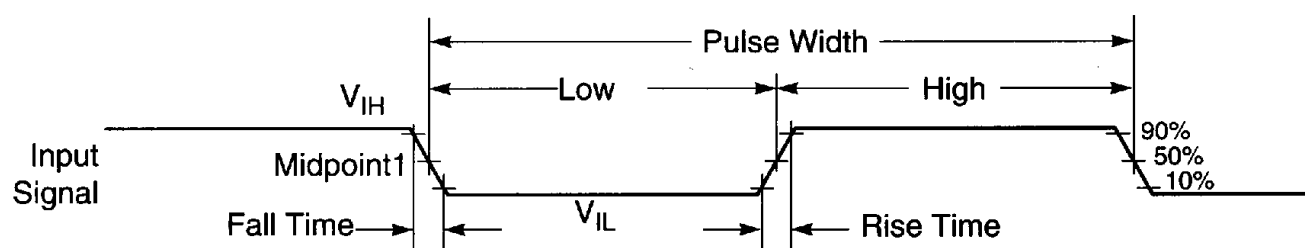
TEST	INPUT						LIMITS (ns)
	J*	SET*	RESET*	K*	Q*	G*	
Setup "1" J	B	2.5 V	F	Gnd	G	H	10
Hold "1" J	C	2.5 V	F	Gnd	G	H	0**
Setup "0" J	D	2.5 V	F	Gnd	$\leq 0.4$ V	$\geq 2.5$ V	10
Hold "0" J	E	2.5 V	F	Gnd	$\leq 0.4$ V	$\geq 2.5$ V	0**
Setup "1" K	Gnd	F	2.5 V	B	H	Q	10
Hold "1" K	Gnd	F	2.5 V	C	H	Q	0**
Setup "0" K	Gnd	F	2.5 V	D	$\geq 2.5$ V	$\leq 0.4$ V	10
Hold "0" K	Gnd	F	2.5 V	E	$\geq 2.5$ V	$\leq 0.4$ V	0**
$t_{pd+}$	Delay from CLOCK to Q during Setup "1" K test. Delay from CLOCK to $\bar{Q}$ during Setup "1" K test.						10
$t_{pd-}$	Delay from CLOCK to $\bar{Q}$ during Setup "1" J test. Delay from CLOCK to Q during Setup "1" J test.						10
$t_{pd+}$	Delay from SET to Q during Setup "1" K test. Delay from RESET to $\bar{Q}$ during Setup "1" J test.						10
$t_{pd-}$	Delay from SET to $\bar{Q}$ during Setup "1" K test. Delay from RESET to Q during Setup "1" J test.						10

\*Letters shown in those columns refer to waveforms shown at the left.  
\*\*Zero is typically a negative number.

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## AC ELECTRICAL CHARACTERISTICS

The timing waveforms in the AC Electrical Characteristics are tested with a  $V_{IL}$  maximum of 0.5 V and a  $V_{IH}$  minimum of 2.4 V for all pins, except EXTAL, RESET, MODA, MODB, and MODC. These pins are tested using the input levels set forth in the DC Electrical Characteristics. AC timing specifications that are referenced to a device input signal are measured in production with respect to the 50% point of the respective input signal's transition. DSP56002 output levels are measured with the production test machine  $V_{OL}$  and  $V_{OH}$  reference levels set at 0.8 V and 2.0 V, respectively.



Note: The midpoint is  $V_{IL} + (V_{IH} - V_{IL})/2$ .

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**Figure 2-1** Signal Measurement Reference