

SCANSWITCH™

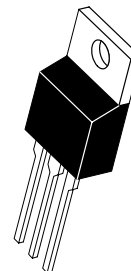
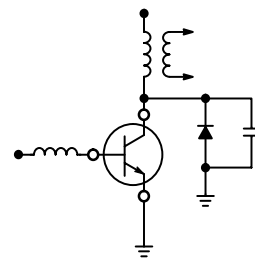
NPN Bipolar Power Deflection Transistor For High and Very High Resolution Monitors

The MJE16204 is a state-of-the-art SWITCHMODE™ bipolar power transistor. It is specifically designed for use in horizontal deflection circuits for 20 mm diameter neck, high and very resolution, full page, monochrome monitors.

- **550 Volt Collector-Base Breakdown Capability**
- Typical Dynamic Desaturation Specified (New Turn-Off Characteristic)
- Application Specific State-of-the-Art Die Design
- Isolated or Non-Isolated TO-220 Type Packages
- Fast Switching:
 - 65 ns Inductive Fall Time (Typ)
 - 680 ns Inductive Storage Time (Typ)
- Low Saturation Voltage:
 - 0.4 Volts at 3.0 Amps Collector Current and 400 mA Base Drive
- Low Collector-Emitter Leakage Current —
 - 100 μ A Max at 550 Volts — V_{CES}
- High Emitter-Base Breakdown Capability For High Voltage Off Drive Circuits — 9.0 Volts (Min)
- Case 221D is UL Recognized at 3500 V_{RMS} : File #E69369

MJE16204

POWER TRANSISTORS
6.0 AMPERES
550 VOLTS — V_{CES}
45 AND 80 WATTS



CASE 221A-09
TO-220AB
MJE16204

Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

MJE16204

MAXIMUM RATINGS

Rating	Symbol	MJE16204	Unit
Collector–Emitter Breakdown Voltage	V_{CES}	550	Vdc
Collector–Emitter Sustaining Voltage	$V_{CEO(sus)}$	250	Vdc
Emitter–Base Voltage	V_{EBO}	8.0	Vdc
RMS Isolation Voltage(2) (for 1 sec, $T_A = 25^\circ\text{C}$, Rel. Humidity < 30%)	V_{ISOL}	— — —	V
Collector Current — Continuous — Pulsed (1)	I_C I_{CM}	6.0 8.0	Adc
Base Current — Continuous — Pulsed (1)	I_B I_{BM}	2.0 4.0	Adc
Repetitive Emitter–Base Avalanche Energy	$W_{(BER)}$	0.2	mJ
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$ Derated above $T_C = 25^\circ\text{C}$	P_D	80 32 0.64	Watts W/ $^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{stg}	–55 to 150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.56	$^\circ\text{C}/\text{W}$
Lead Temperature for Soldering Purposes 1/8" from the case for 5 seconds	T_L	260	$^\circ\text{C}$

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle \leq 10%.

(2) Proper strike and creepage distance must be provided.

*Measurement made with thermocouple contacting the bottom insulated mounting surface of the package (in a location beneath the die), the device mounted on a heatsink thermal grease applied, and a mounting torque of 6 to 8 in•lbs.

MJE16204

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

OFF CHARACTERISTICS (3)

Collector Cutoff Current ($V_{CE} = 550\text{ Vdc}$, $V_{BE} = 0\text{ V}$)	I_{CES}	—	—	100	μAdc
Emitter–Base Leakage ($V_{EB} = 8.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	—	10	μAdc
Emitter–Base Breakdown Voltage ($I_E = 1.0\text{ mA}$, $I_C = 0$)	$V_{(BR)EBO}$	8.0	11	—	Vdc
Collector–Emitter Sustaining Voltage (Table 1) ($I_C = 10\text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	250	325	—	Vdc

ON CHARACTERISTICS (3)

Collector–Emitter Saturation Voltage ($I_C = 1.0\text{ Adc}$, $I_B = 133\text{ mAdc}$) ($I_C = 3.0\text{ Adc}$, $I_B = 400\text{ mAdc}$)	$V_{CE(sat)}$	— —	0.25 0.4	0.6 1.0	Vdc
Base–Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 400\text{ mAdc}$)	$V_{BE(sat)}$	—	0.9	1.5	Vdc
DC Current Gain ($I_{CE} = 6.0\text{ Adc}$, $V_{CE} = 5.0\text{ Vdc}$)	h_{FE}	8.0	14	20	—

DYNAMIC CHARACTERISTICS

Dynamic Desaturation Interval ($I_C = 3.0\text{ A}$, $I_{B1} = 400\text{ mA}$)	t_{ds}	—	50	—	ns
Output Capacitance ($V_{CE} = 10\text{ Vdc}$, $I_E = 0$, $f_{test} = 100\text{ kHz}$)	C_{ob}	—	90	150	pF
Gain Bandwidth Product ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ A}$, $f_{test} = 1.0\text{ MHz}$)	f_T	10	—	—	MHz
Emitter–Base Turn–Off Energy ($EB_{(avalanche)} = 500\text{ ns}$, $R_{BE} = 22\ \Omega$)	$EB_{(off)}$	—	6.6	—	μJ
Collector–Heatsink Capacitance (Mounted on a 1" x 2" x 1/16" Copper Heatsink, $V_{CE} = 0$, $f_{test} = 100\text{ kHz}$)	C_{c-hs}	—	3.0	—	pF

SWITCHING CHARACTERISTICS

Inductive Load (Table 2) ($I_C = 3.0\text{ A}$, $I_B = 400\text{ mA}$)					ns
Storage	t_{sv}	—	680	1500	
Fall Time	t_{fi}	—	65	150	

(3) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

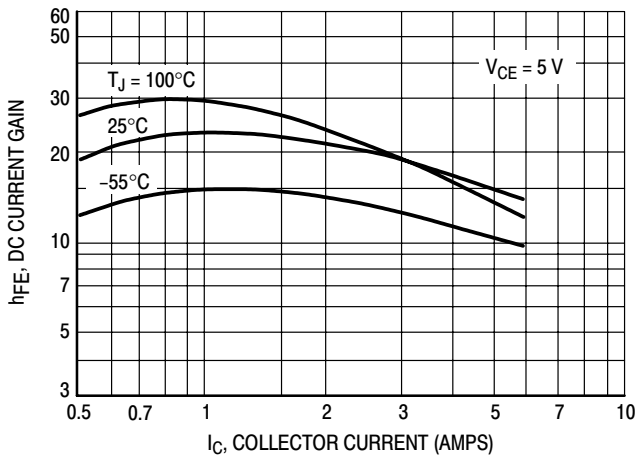


Figure 1. Typical DC Current Gain

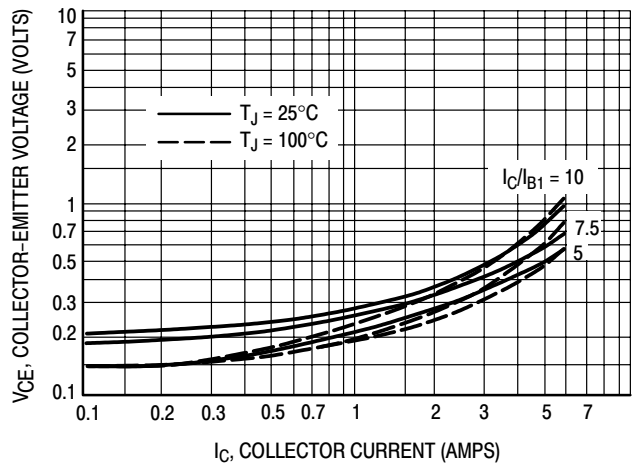


Figure 2. Typical Collector-Emitter Saturation Voltage

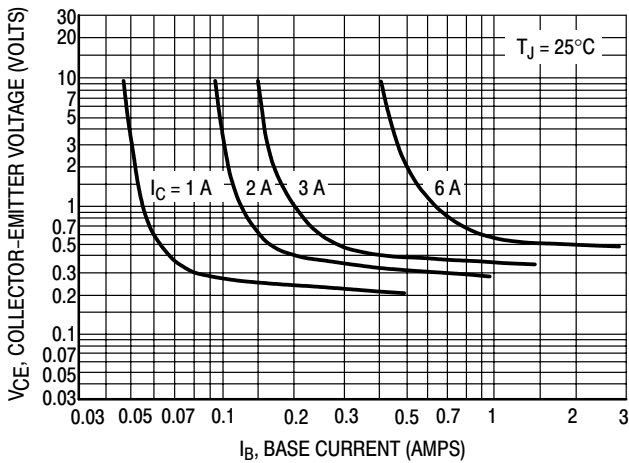


Figure 3. Typical Collector-Emitter Saturation Region

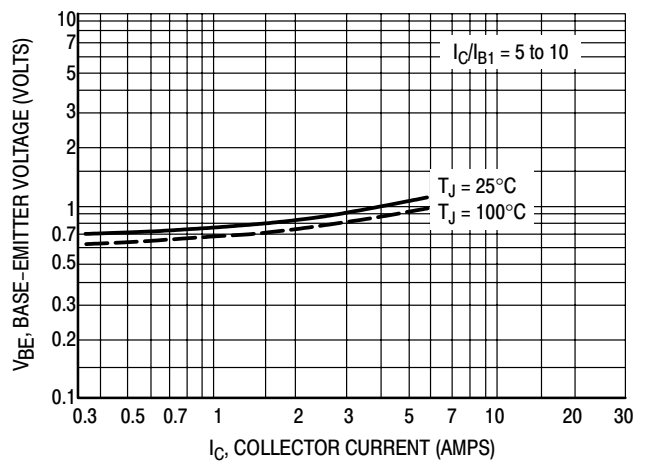


Figure 4. Typical Base-Emitter Saturation Voltage

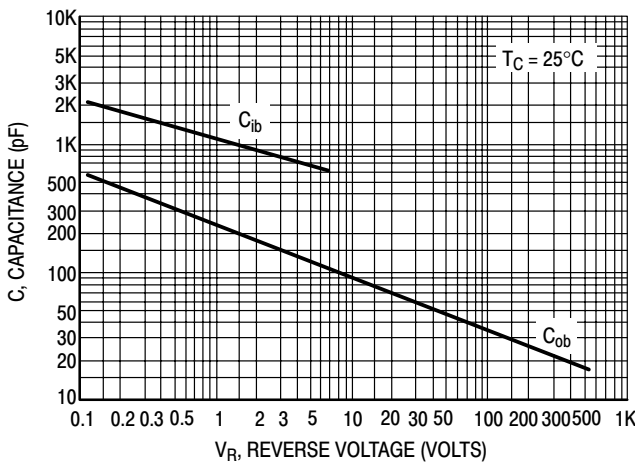


Figure 5. Typical Capacitance

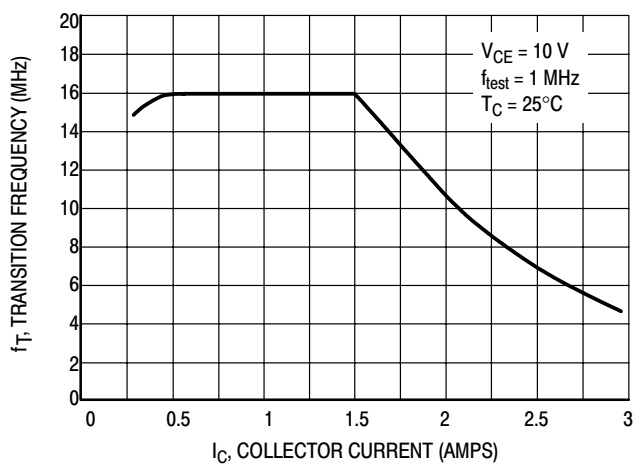


Figure 6. Typical Transition Frequency

SAFE OPERATING AREA

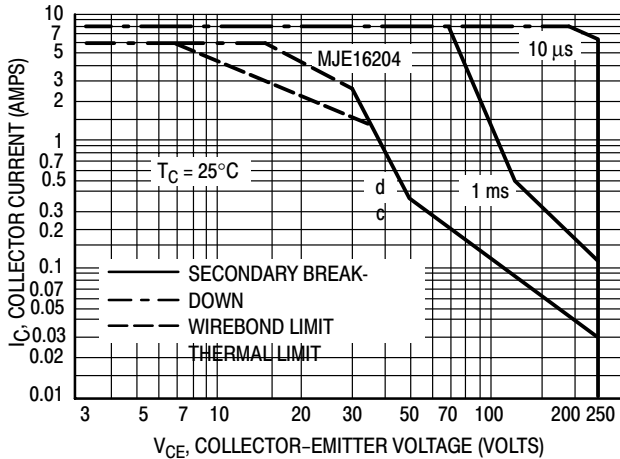


Figure 7. Maximum Forward Biased Safe Operating Area

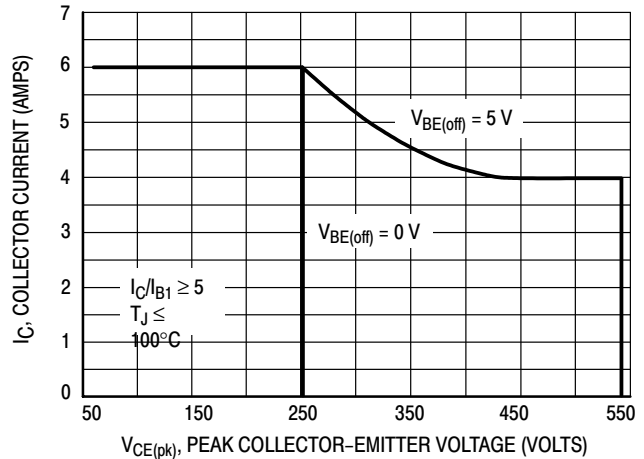


Figure 8. Maximum Reverse Biased Safe Operating Area

SAFE OPERATING AREA INFORMATION

FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 7 is based on $T_C = 25^\circ\text{C}$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geq 25^\circ\text{C}$. Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 7 may be found at any case temperature by using the appropriate curve on Figure 9.

At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base-to-emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc.

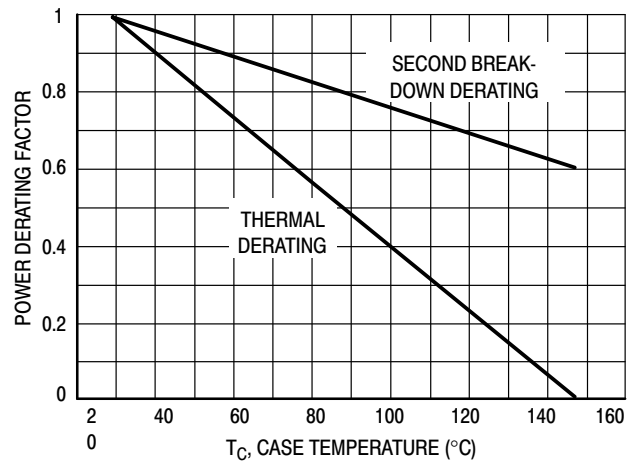
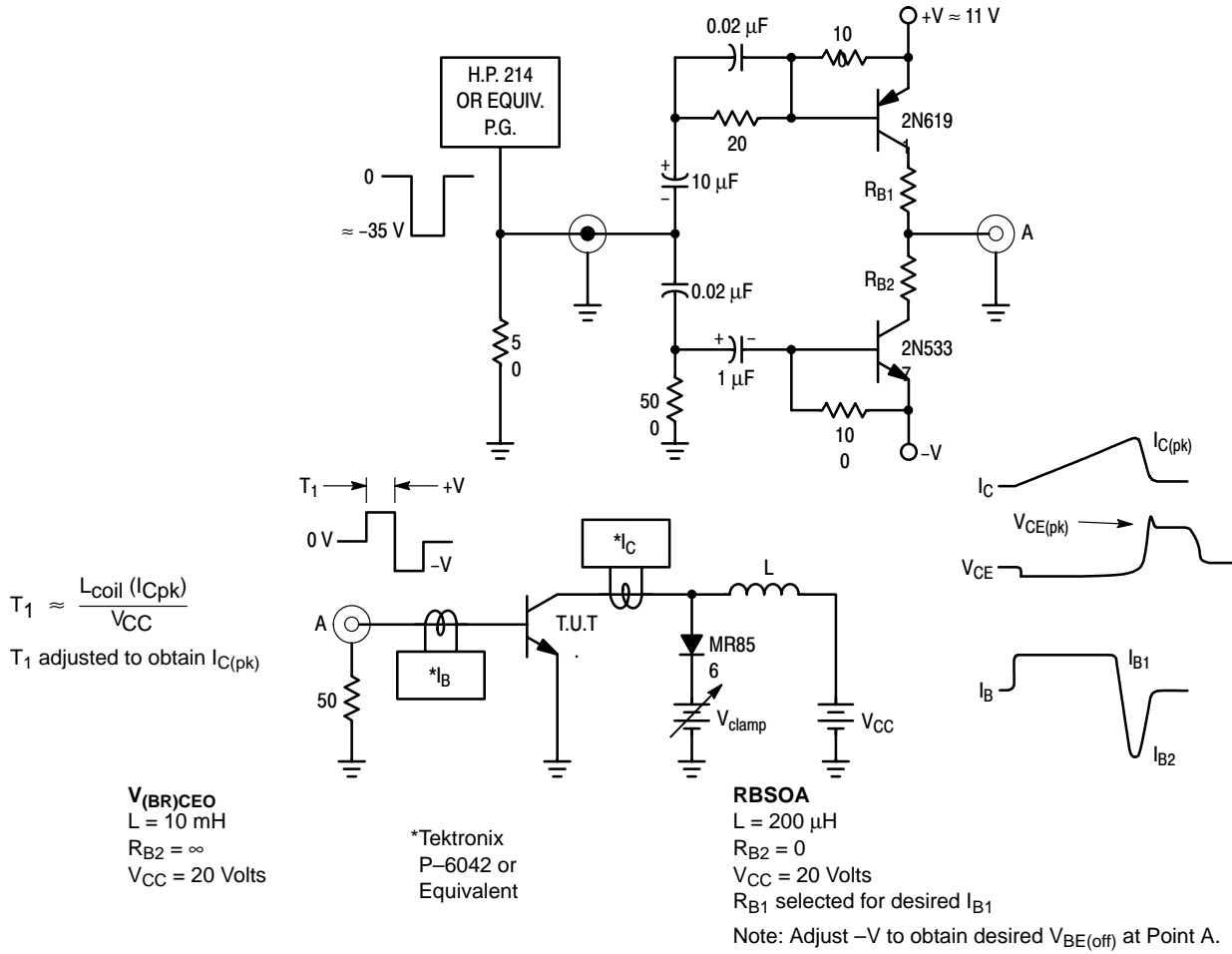


Figure 9. Power Derating

The safe level for these devices is specified as Reverse Biased Safe Operating Area and represents the voltage-current condition allowable during reverse biased turnoff. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 8 gives the RBSOA characteristics.

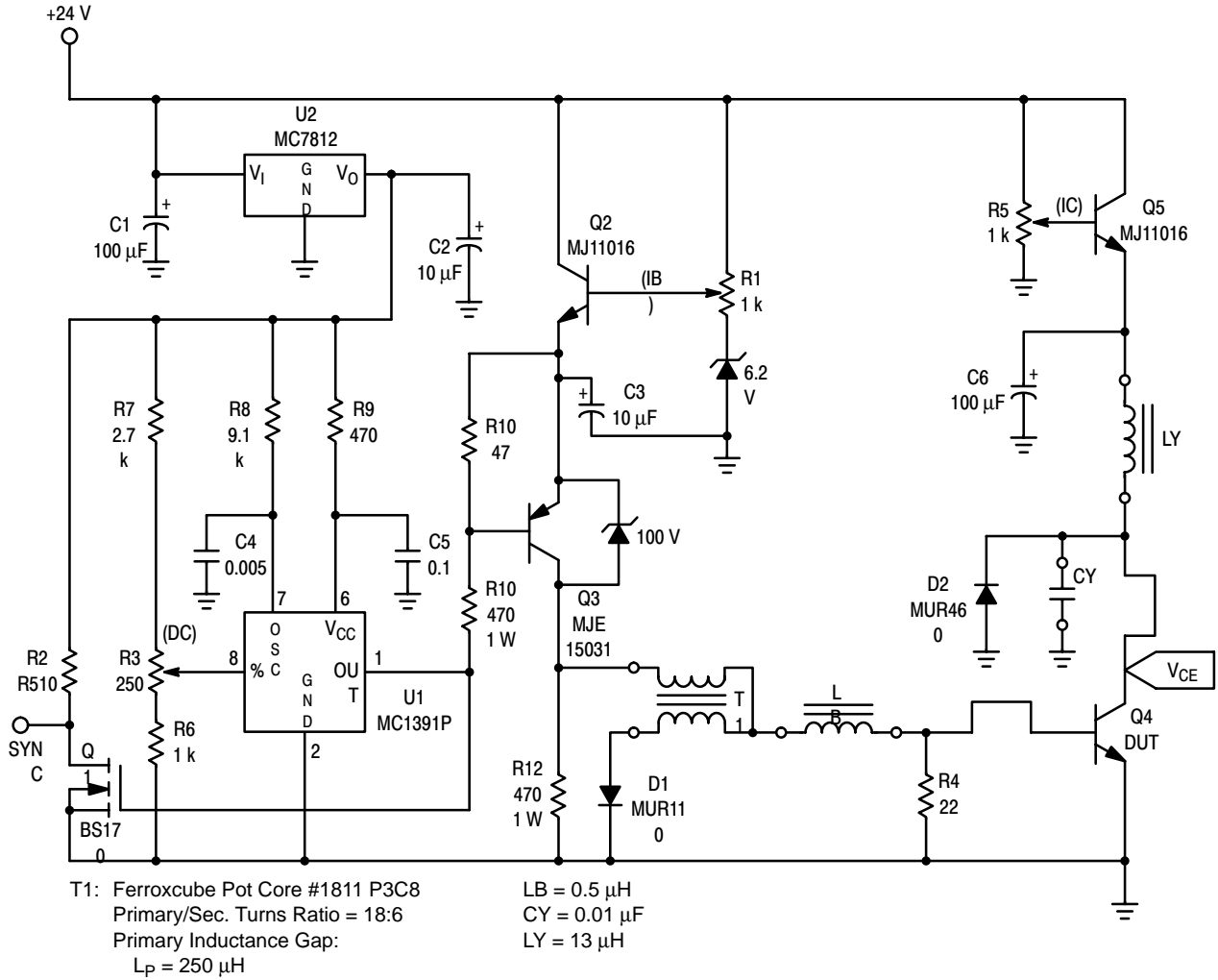
MJE16204

Table 1. RBSOA/ $V_{(BR)CEO(sus)}$ Test Circuit



MJE16204

Table 2. High Resolution Deflection Application Simulator



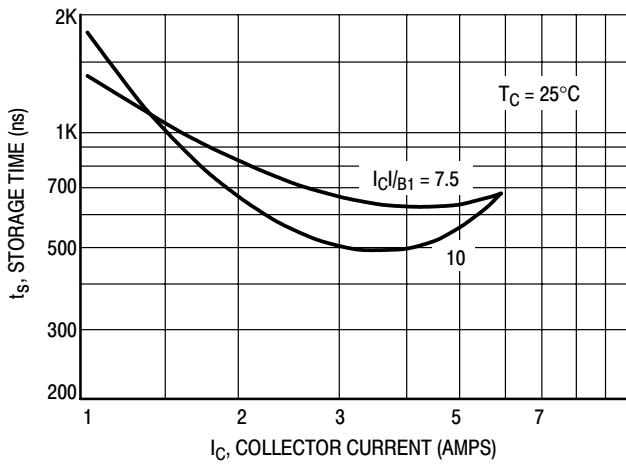


Figure 10. Typical Collector Current Storage Time in Deflection Circuit Simulator

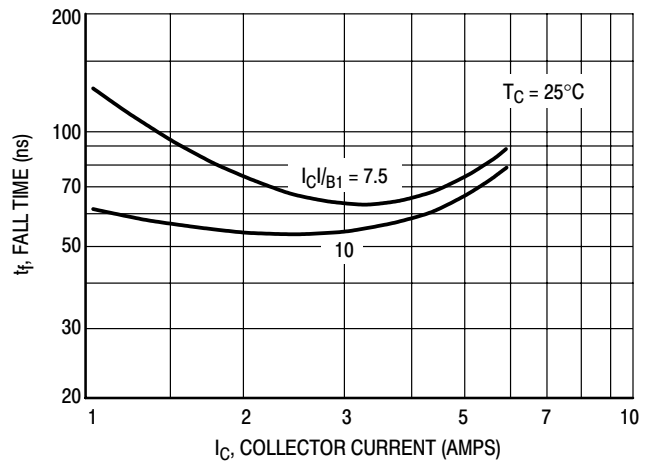


Figure 11. Typical Collector Current Fall Time in Deflection Circuit Simulator

DYNAMIC DESATURATIION

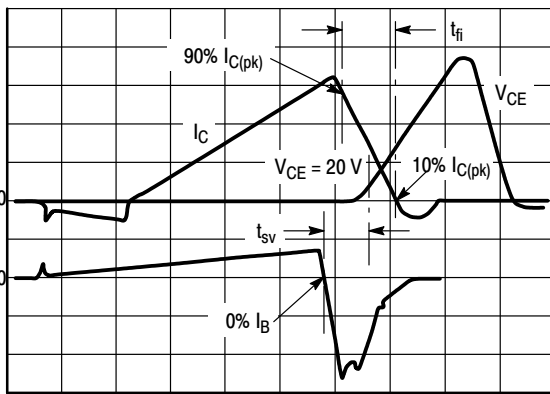


Figure 12. Deflection Simulator Switching Waveforms From Circuit in Table 2

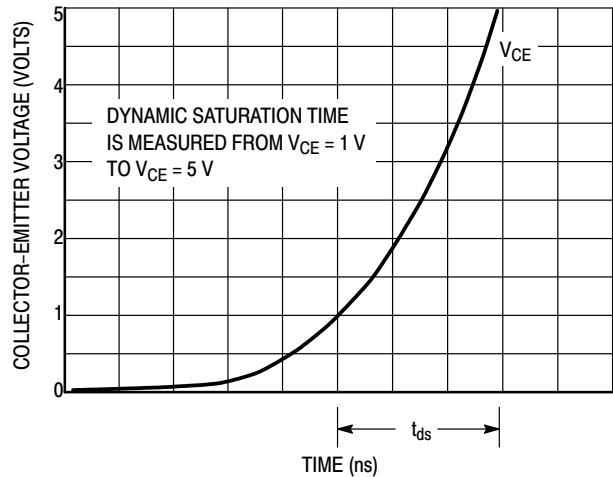


Figure 13. Definition of Dynamic Saturation Measurement

The SCANSWITCH series of bipolar power transistors are specifically designed to meet the unique requirements of horizontal deflection circuits in computer monitor applications. Historically, deflection transistor design was focused on minimizing collector current fall time. While fall time is a valid figure of merit, a more important indicator of circuit performance as scan rates are increased is a new characteristic, "dynamic desaturation." In order to assure a linear collector current ramp, the output transistor must remain in hard saturation during storage time and exhibit a rapid turn-off transition. A sluggish transition results in serious consequences. As the saturation voltage of the output transistor increases, the voltage across the yoke

drops. Roll off in the collector current ramp results in improper beam deflection and distortion of the image at the right edge of the screen. Design changes have been made in the structure of the SCANSWITCH series of devices which minimize the dynamic desaturation interval. Dynamic desaturation has been defined in terms of the time required for the V_{CE} to rise from 1.0 to 5.0 volts (Figures 12 and 13) and typical performance at optimized drive conditions has been specified. Optimization of device structure results in a linear collector current ramp, excellent turn-off switching performance, and significantly lower overall power dissipation.

MJE16204

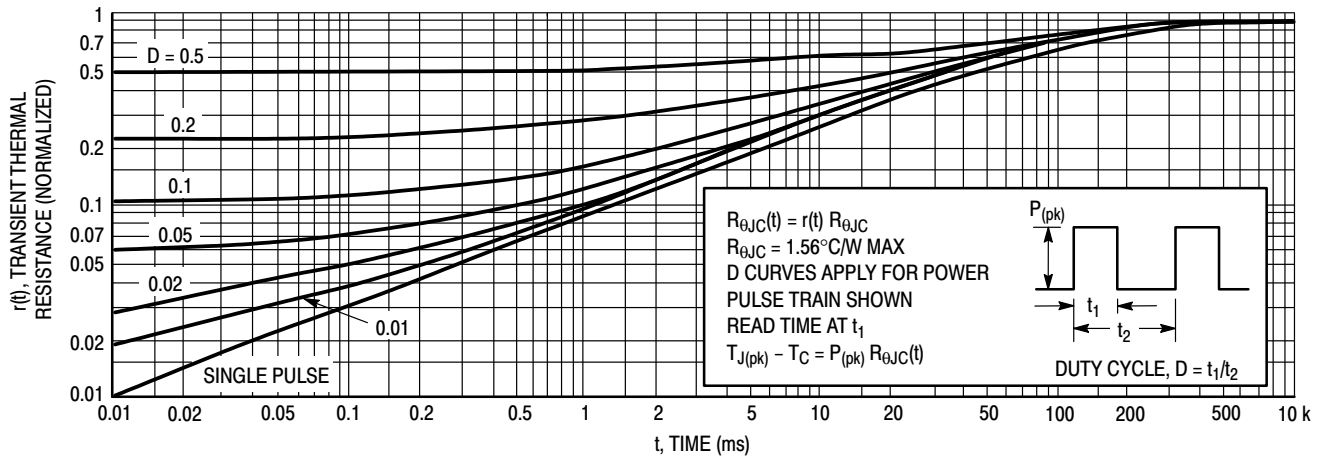
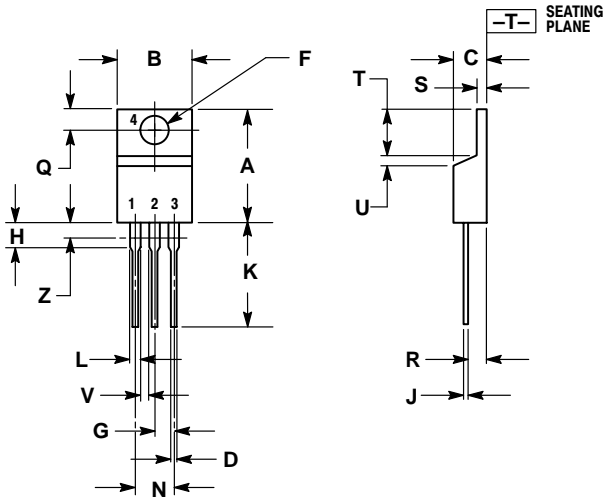


Figure 14. Typical Thermal Response for MJE16204

MJE16204

PACKAGE DIMENSIONS TO-220AB CASE 221A-09 ISSUE AA




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

Notes

SWITCHMODE is a trademark of Semiconductor Components Industries, LLC.

SCANSWITCH is a trademark of Semiconductor Components Industries, LLC.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

PUBLICATION ORDERING INFORMATION

NORTH AMERICA Literature Fulfillment:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com
Fax Response Line: 303-675-2167 or 800-344-3810 Toll Free USA/Canada

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

EUROPE: LDC for ON Semiconductor – European Support

German Phone: (+1) 303-308-7140 (Mon-Fri 2:30pm to 7:00pm CET)
Email: ONlit-german@hibbertco.com
French Phone: (+1) 303-308-7141 (Mon-Fri 2:00pm to 7:00pm CET)
Email: ONlit-french@hibbertco.com
English Phone: (+1) 303-308-7142 (Mon-Fri 12:00pm to 5:00pm GMT)
Email: ONlit@hibbertco.com

EUROPEAN TOLL-FREE ACCESS*: 00-800-4422-3781

*Available from Germany, France, Italy, UK, Ireland

CENTRAL/SOUTH AMERICA:

Spanish Phone: 303-308-7143 (Mon-Fri 8:00am to 5:00pm MST)
Email: ONlit-spanish@hibbertco.com
Toll-Free from Mexico: Dial 01-800-288-2872 for Access –
then Dial 866-297-9322

ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support

Phone: 1-303-675-2121 (Tue-Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001-800-4422-3781
Email: ONlit-asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031
Phone: 81-3-5740-2700
Email: r14525@onsemi.com

ON Semiconductor Website: <http://onsemi.com>

For additional information, please contact your local Sales Representative.