Complementary Silicon High-Power Transistors

2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

These PowerBase complementary transistors are designed for high power audio, stepping motor and other linear applications. These devices can also be used in power switching circuits such as relay or solenoid drivers, dc−to−dc converters, inverters, or for inductive loads requiring higher safe operating area than the 2N3055.

Features

- High Current−Gain − Bandwidth
- Safe Operating Area
- These Devices are Pb−Free and are RoHS Compliant*

MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Collector−Emitter Voltage 2N3055AG MJ15015G, MJ15016G	V_{CEO}	60 120	Vdc
Collector−Base Voltage 2N3055AG MJ15015G, MJ15016G	V_{CBO}	100 200	Vdc
Collector−Emitter Voltage Base Reversed Biased 2N3055AG MJ15015G, MJ15016G	V_{CEV}	100 200	Vdc
Emitter−Base Voltage	V_{EBO}	7.0	Vdc
Collector Current − Continuous	I_C	15	Adc
Base Current	I_B	7.0	Adc
Total Device Dissipation @ T_C = 25°C 2N3055AG MJ15015G, MJ15016G Derate above 25°C 2N3055AG MJ15015G, MJ15016G	P_D	115 180 0.65 1.03	W W W/°C W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. Indicates JEDEC Registered Data. (2N3055A)

THERMAL CHARACTERISTICS

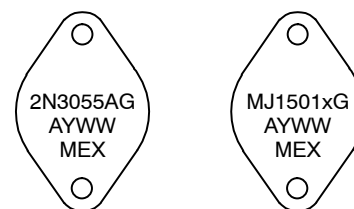| Characteristics	Symbol	Max	Max	Unit
Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	1.52	0.98	°C/W

*For additional information on our Pb−Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

15 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS
60, 120 VOLTS − 115, 180 WATTS

PNP   CASE 3
BASE 1
EMITTER 2

NPN   CASE 3
BASE 1
EMITTER 2

CASE

2
1
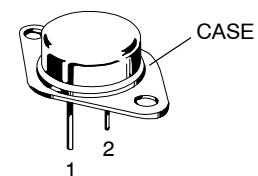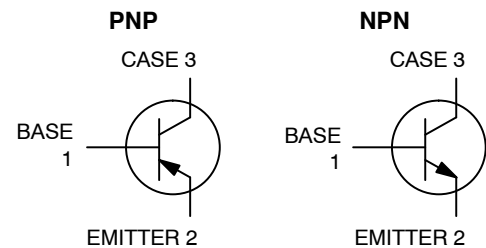
TO−204 (TO−3)
CASE 1−07
STYLE 1

MARKING DIAGRAMS

2N3055AG
AYWW
MEX

MJ1501xG
AYWW
MEX

2N3055A = Device Code
MJ1501x = Device Code
x = 5 or 6
G = Pb−Free Package
A = Assembly Location
Y = Year
WW = Work Week
MEX = Country of Origin

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS (Note 2)				
Collector−Emitter Sustaining Voltage (Note 3) 2N3055AG (I_C = 200 mAdc, I_B = 0) MJ15015G, MJ15016G	$V_{CEO(sus)}$	60 120	− −	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, $V_{BE(off)}$ = 0 Vdc) 2N3055AG (V_{CE} = 60 Vdc, $V_{BE(off)}$ = 0 Vdc) MJ15015G, MJ15016G	I_{CEO}	− −	0.7 0.1	mAdc
Collector Cutoff Current (Note 3) 2N3055AG (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc) MJ15015G, MJ15016G	I_{CEV}	− −	5.0 1.0	mAdc
Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, 2N3055AG T_C = 150°C) MJ15015G, MJ15016G	I_{CEV}	− −	30 6.0	mAdc
Emitter Cutoff Current 2N3055AG (V_{EB} = 7.0 Vdc, I_C = 0) MJ15015G, MJ15016G	I_{EBO}	− −	5.0 0.2	mAdc
SECOND BREAKDOWN (Note 3)				
Second Breakdown Collector Current with Base Forward Biased (t = 0.5 s non−repetitive) 2N3055AG (V_{CE} = 60 Vdc) MJ15015G, MJ15016G	$I_{S/b}$	1.95 3.0	− −	Adc
ON CHARACTERISTICS (Note 2 and 3)				
DC Current Gain (I_C = 4.0 Adc, V_{CE} = 2.0 Vdc) (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc) (I_C = 10 Adc, V_{CE} = 4.0 Vdc)	h_{FE}	10 20 5.0	70 70 −	−
Collector−Emitter Saturation Voltage (I_C = 4.0 Adc, I_B = 400 mAdc) (I_C = 10 Adc, I_B = 3.3 Adc) (I_C = 15 Adc, I_B = 7.0 Adc)	$V_{CE(sat)}$	− − −	1.1 3.0 5.0	Vdc
Base−Emitter On Voltage (I_C = 4.0 Adc, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$	0.7	1.8	Vdc
DYNAMIC CHARACTERISTICS (Note 3)				
Current−Gain − Bandwidth Product 2N3055AG, MJ15015G (I_C = 1.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz) MJ15016G	f_T	0.8 2.2	6.0 18	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	60	600	pF

SWITCHING CHARACTERISTICS (2N3055AG only) (Note 3)

RESISTIVE LOAD					
Delay Time		t_d	−	0.5	μs
Rise Time	(V_{CC} = 30 Vdc, I_C = 4.0 Adc,	t_r	−	4.0	μs
Storage Time	I_{B1} = I_{B2} = 0.4 Adc, t_p = 25 μs Duty Cycle ≤ 2%	t_s	−	3.0	μs
Fall Time		t_f	−	6.0	μs

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
2. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.
3. Indicates JEDEC Registered Data. (2N3055A)

2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)
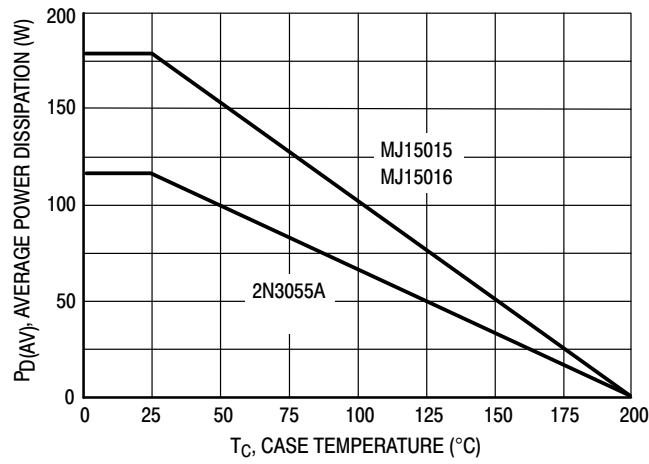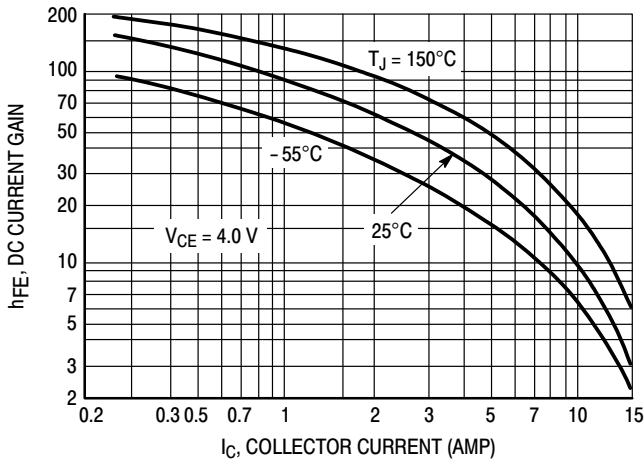

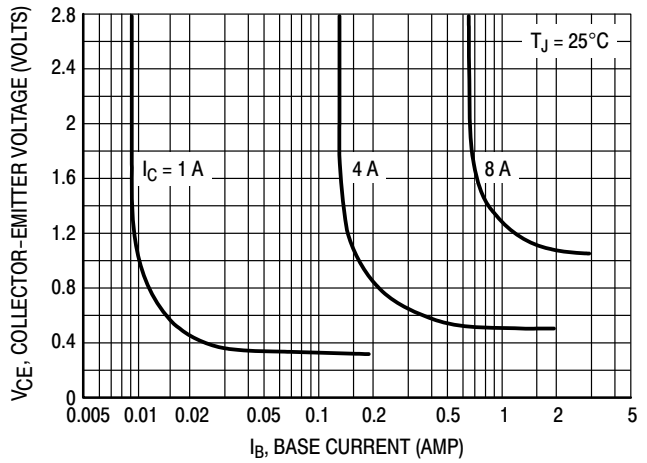Figure 1. Power Derating

Figure 2. DC Current Gain

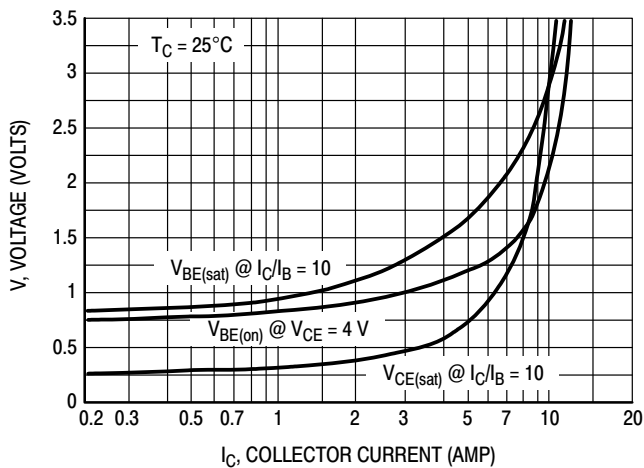Figure 3. Collector Saturation Region
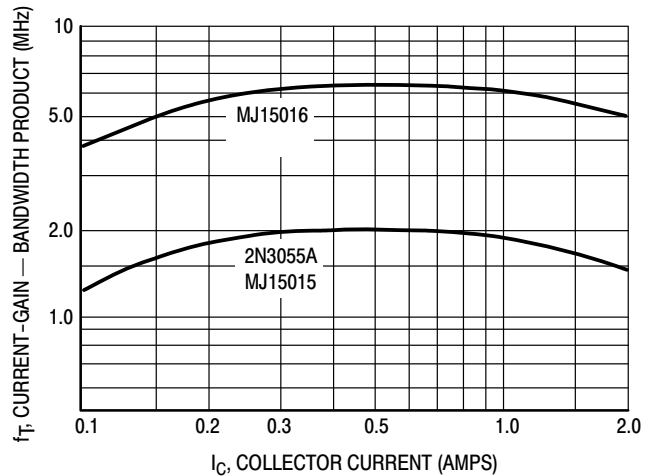

Figure 4. "On" Voltages

Figure 5. Current–Gain – Bandwidth Product

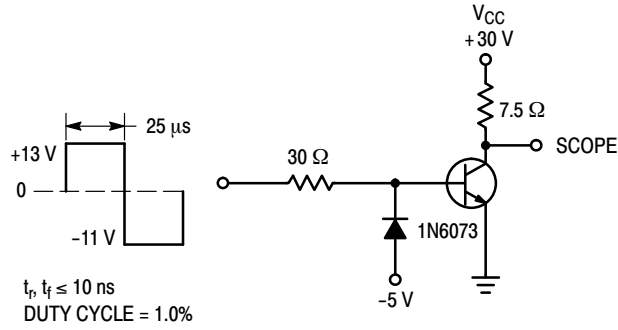# 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

Figure 6. Switching Times Test Circuit
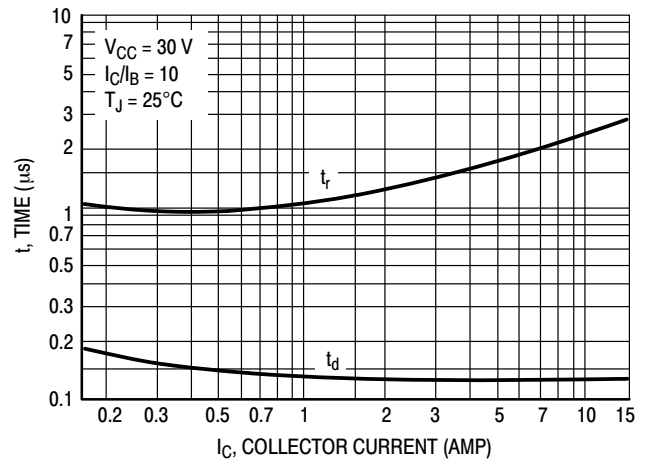(Circuit shown is for NPN)
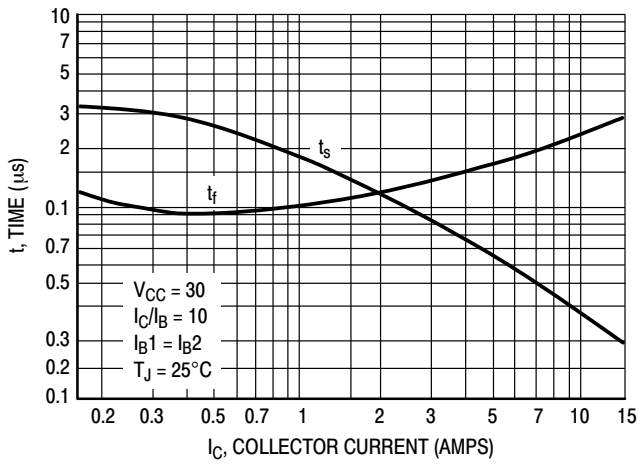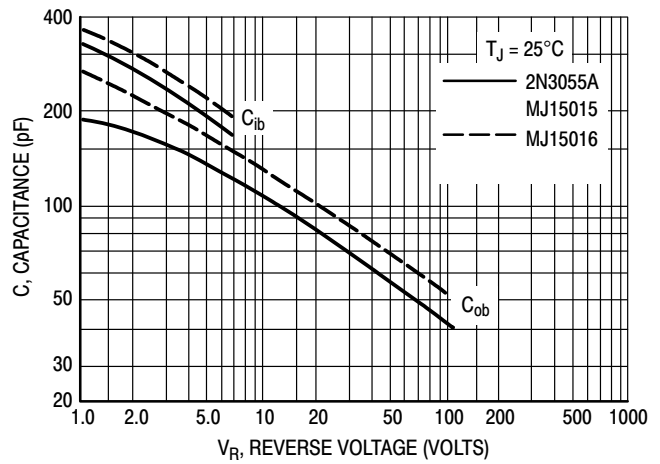
Figure 7. Turn−On Time

Figure 8. Turn−Off Times

Figure 9. Capacitances

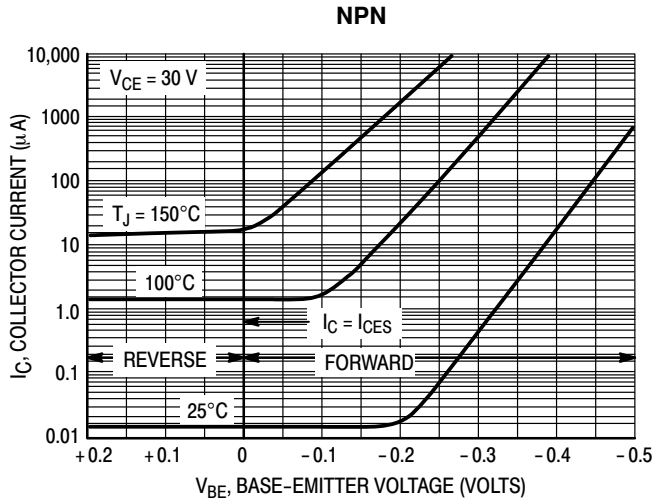# 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

COLLECTOR CUT−OFF REGION

NPN

Figure 10. 2N3055A, MJ15015

PNP
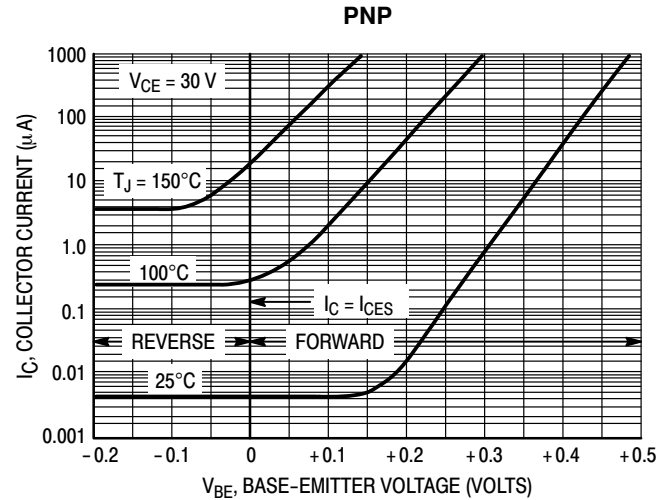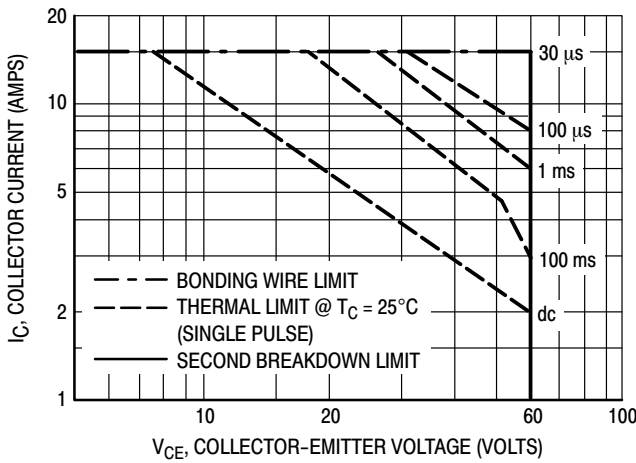
Figure 11. MJ15016

**Figure 12. Forward Bias Safe Operating Area
2N3055A**
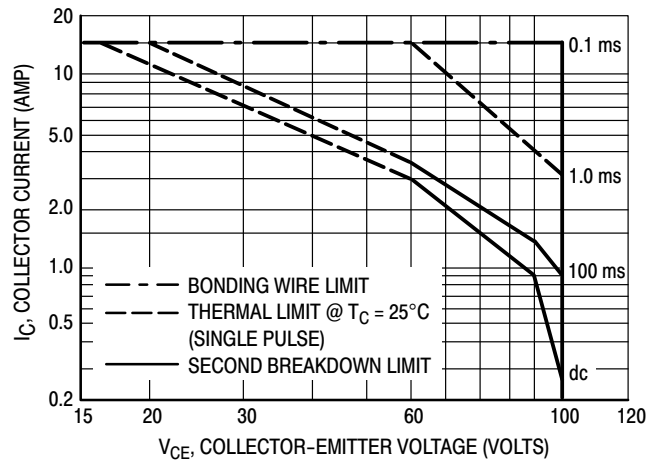
**Figure 13. Forward Bias Safe Operating Area
MJ15015, MJ15016**

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 Figures 12 and 13 is based on $T_C = 25°C$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated for temperature according to Figure 1.

ORDERING INFORMATION

Device	Package	Shipping
2N3055AG	TO−204 (Pb−Free)	100 Units / Tray
MJ15015G	TO−204 (Pb−Free)	100 Units / Tray
MJ15016G	TO−204 (Pb−Free)	100 Units / Tray
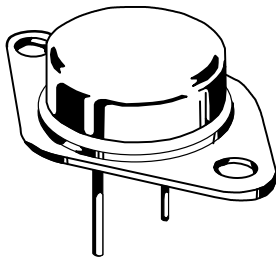
TO−204 (TO−3)
CASE 1−07
ISSUE Z

DATE 10 MAR 2000

SCALE 1:1
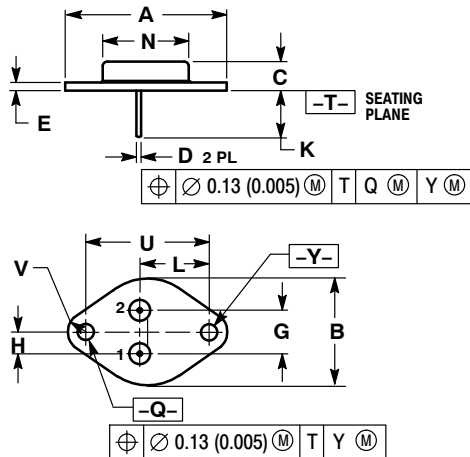
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO−204AA OUTLINE SHALL APPLY.

SEATING PLANE

⊕ ⌀ 0.13 (0.005) Ⓜ T Q Ⓜ Y Ⓜ

⊕ ⌀ 0.13 (0.005) Ⓜ T Y Ⓜ

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.550 REF		39.37 REF	
B	---	1.050	---	26.67
C	0.250	0.335	6.35	8.51
D	0.038	0.043	0.97	1.09
E	0.055	0.070	1.40	1.77
G	0.430 BSC		10.92 BSC	
H	0.215 BSC		5.46 BSC	
K	0.440	0.480	11.18	12.19
L	0.665 BSC		16.89 BSC	
N	---	0.830	---	21.08
Q	0.151	0.165	3.84	4.19
U	1.187 BSC		30.15 BSC	
V	0.131	0.188	3.33	4.77

STYLE 1:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR

STYLE 2:
PIN 1. BASE
2. COLLECTOR
CASE: EMITTER

STYLE 3:
PIN 1. GATE
2. SOURCE
CASE: DRAIN

STYLE 4:
PIN 1. GROUND
2. INPUT
CASE: OUTPUT

STYLE 5:
PIN 1. CATHODE
2. EXTERNAL TRIP/DELAY
CASE: ANODE

STYLE 6:
PIN 1. GATE
2. EMITTER
CASE: COLLECTOR

STYLE 7:
PIN 1. ANODE
2. OPEN
CASE: CATHODE

STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE: ANODE

STYLE 9:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE

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DESCRIPTION:	TO−204 (TO−3)		PAGE 1 OF 1

ADDITIONAL INFORMATION

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