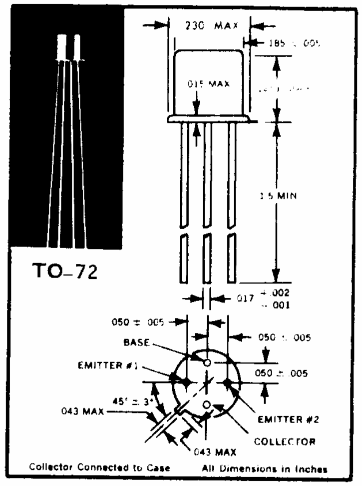
HIGH VOLTAGE
SILICON EPITAXIAL JUNCTION
INTEGRATED CHOPPER TRANSISTOR

3N123



ELECTRICAL DATA ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	3N123	UNITS
Collector to Base Voltage	BV	30	V
Emitter (1) to Base Voltage	BV	25	V
Emitter (2) to Base Voltage	BV	25	V
Emitter to Emitter Voltage	BV	25	V
Emitter (1) to Collector Voltage	BV	25	V
Emitter (2) to Collector Voltage	BV	25	V
DC Collector Current	I	20	mA
DC Base Current	I	20	mA
DC Emitter Current	I	10	mA
Power Diss. 25°C Ambient	P	100 Derating 0.57 mW/°C	
Junction Temp. (Oper. & Stor.)	T	-65°C to +200°C	
Lead Temp. (1/16" from Case)	T	240°C for 10 sec.	

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$ (UNLESS OTHERWISE STATED)

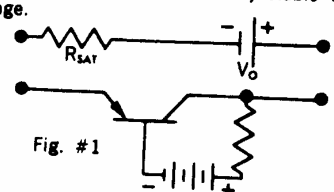
PARAMETER	SYMBOL	CONDITIONS	3N123 Min.	3N123 Max.	UNITS
Collector Cutoff Current	I_{CBO}	$V_{CB} = -25V$, $I_{E_1} = I_{E_2} = 0$		10	nA
Emitter Cutoff Current	$I_{E_1E_2O}$	$V_{E_1E_2} = \pm 10V$, $V_{CB} = 0$		±1	nA
Emitter Cutoff Current	$I_{E_1E_2O}$	$V_{E_1E_2} = \pm 10V$, $V_{CB} = 0$, $T_A = 100°C$		±100	nA
Emitter Base Cutoff Current	I_{E_1BO}	V_{E_1B} (or V_{E_2B}) = -10V I_{E_2} (or I_{E_1}) = 0, $I_C = 0$		1	nA
Offset Voltage	V_O	I_B = -mA, $I_{E_1} = I_{E_2} = 0$, T_A = 0°C, 25°C & 85°C		250	µV
Offset Voltage/Temp.	$\Delta V_{E_1E_2O}$	$I_B(1) = -0.5mA$, $I_B(2) = 1.5mA$ $I_{E_1} = I_{E_2} = 0$		100	µV
Offset Voltage/I_B	$\Delta V_{E_1E_2O}$	$T_A(1) = 0°C$, $T_A(2) = +85°C$ $I_B = -1mA$, $I_{E_1} = I_{E_2} = 0$		150	µV
Emitter to Base Capacitance	C_{eb}	V_{E_1B} (or V_{E_2B}) = -6V, $I_C = 0$, f = 4MHz		3	pf
Collector to Base Capacitance	C_{ob}	$V_{CB} = -6V$, $I_E = I_{E_2} = 0$, f = 4MHz		10	pf
Forward Current Gain	h_{fe}	V_{CE_1} (or V_{CE_2}) = -6V, $I_C = -1mA$, f = 4MHz	1.5		
Series "ON" Resistance	$r_{e_1e_2}$	$I_B = -1mA$, $I_E = I_{E_2} = 0$ $I_{E_1} = I_{E_2} = 100\mu A$, f = 60HZ	10	100	Ohms

CRYSTALONCS
2805 Veterans Highway
Suite 14
Ronkonkoma, N.Y. 11779

Crystalonics, Inc. APPLICATION NOTES

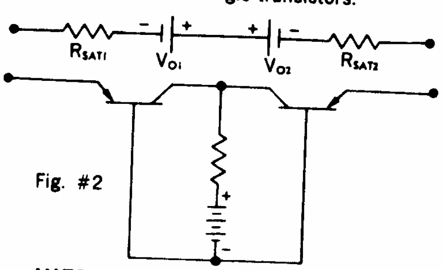
APPLICATIONS OF INTEGRATED CHOPPERS

When used as a switch the junction transistor exhibits two predominant imperfections (see Fig. #1). One of these is the saturation resistance which is usually small enough to be disregarded. The other is offset voltage. Offset voltage appears as a potential in series with the signal path and decreases with increasing reverse beta. Since turning a transistor upside down makes its forward beta its reverse beta and vice versa, most low-level switching transistors are specified in the inverted mode. The resulting offset voltages are in the order of 1mV. The offset voltage is temperature and drive current sensitive. Were it not, it might be easily cancelled with an adjustable series voltage.



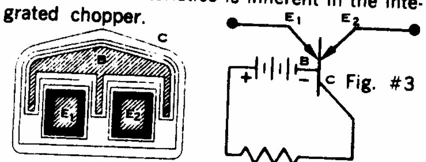
TRANSISTOR SWITCH AND ERRORS

The alternative is to use two series transistors with matched offset voltage. A 50μV match over a broad temperature range may be obtained in this manner (see Fig. #2). Note that the total R_{SAT} is twice that of single transistors.



MATCHED PAIR SWITCH AND ERRORS

Upon examination the matched pair can be seen to have a common collector and common base. Thus the pair could be replaced by a single transistor with two emitters. This is the integrated chopper (see Fig. #3). Because of the proximity of the two emitters, an excellent match of characteristics is inherent in the integrated chopper.



INTEGRATED CHOPPER

From a user's standpoint there are several advantages to the integrated chopper.

(1) There is no logistics problem in keeping matched pairs together.

(2) There is no problem in maintaining two transistors at exactly the same temperature.

(3) Drive current does not flow through the external signal leads so offset voltage is more stable with changes in drive current.

(4) Reliability is higher due to the use of a single device and a lesser number of interconnections.

(5) The cost is inherently lower than two separate units with all of their necessary testing.

Until recently, integrated choppers had one drawback — standard planar technology will not yield emitter breakdown voltages in excess of 18 volts and that only grudgingly.

The Crystalonics PNP epitaxial junction process has overcome this one drawback, resulting in a low-cost high voltage component for all accurate switching requirements. They may be used in place of standard matched pairs and mechanical choppers with savings in circuit complexity and cost. They may also be used to directly replace earlier low breakdown voltage integrated choppers, including NPN types. The only change necessary to use them in place of NPN types is to reverse the collector and base where phase relationships are important.

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