

# Product Selection Guide

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# Product Descriptions

## Thyristors

A thyristor is any semiconductor switch with a bi-stable action depending on p-n-p-n regenerative feedback. Thyristors are normally two- or three-terminal devices for either unidirectional or bidirectional circuit configurations. Thyristors can have many forms, but they have certain commonalities. All thyristors are solid state switches that are normally open circuits (very high impedance), capable of withstanding rated blocking/off-state voltage until triggered to on state. When triggered to on state, thyristors become a low-impedance current path until principle current either stops or drops below a minimum holding level. After a thyristor is triggered to on-state condition, the trigger current can be removed without turning off the device. Thyristors are used to control the flow of electrical currents in applications including:

- Home appliances (lighting, heating, temperature control, alarm activation, fan speed)
- Electrical tools (for controlled actions such as motor speed, stapling event, battery charging)
- Outdoor equipment (water sprinklers, gas engine ignition, electronic displays, area lighting, sports equipment, physical fitness)

## Sensitive Triacs

Teccor's sensitive gate triacs are AC bidirectional silicon switches that provide guaranteed gate trigger current levels in Quadrants I, II, III, and IV. Interfacing to microprocessors or other equipment with single polarity gate triggering is made possible with sensitive gate triacs. Gate triggering currents of 3 mA, 5 mA, 10 mA, or 20 mA may be specified.

Sensitive gate triacs are capable of controlling AC load currents from 0.8 A to 8 A rms and can withstand operating voltages from 200 V to 600 V.

## Triacs

Teccor's triac products are bidirectional AC switches, capable of controlling loads from 0.8 A to 35 A rms with 10 mA, 25 mA, and 50 mA  $I_{GT}$  in operating Quadrants I, II and III.

Triacs are useful in full-wave AC applications to control AC power either through full-cycle switching or phase control of current to the load element. These triacs are rated to block voltage in the "OFF" condition from 200 V minimum with selected products capable of 1000 V operation. Typical applications include motor speed controls, heater controls, and incandescent light controls.

## Quadrac

*Quadrac* devices, originally developed by Teccor, are triacs and alternistor triacs with a diac trigger mounted inside the same package. These devices save the user the expense and assembly time of buying a discrete diac and assembling in conjunction with a gated triac.

The *Quadrac* is offered in capacities from 4 A to 15 A rms and voltages from 200 V ac to 600 V ac.

## Alternistor Triacs

The Teccor alternistor is specifically designed for applications required to switch highly inductive loads. The design of this special chip effectively offers the same performance as two thyristors (SCRs) wired inverse parallel (back-to-back).

This new chip construction provides the equivalent of two electrically-separate SCR structures, providing enhanced dv/dt characteristics while retaining the advantages of a single-chip device.

Teccor manufactures 6 A to 40 A alternistors with blocking voltage rating from 200 V to 1000 V. Alternistors are offered in TO-220, TO-218, and TO-218X packages with isolated and non-isolated versions.

## Sensitive SCRs

Teccor's sensitive gate SCRs are silicon-controlled rectifiers representing the best in design, performance, and packaging techniques for low- and medium-current applications.

Anode currents of 0.8 A to 10 A rms can be controlled by sensitive gate SCRs with gate drive currents ranging from 12  $\mu$ A to 500  $\mu$ A. Sensitive gate SCRs are ideally suited for interfacing to integrated circuits or in applications where high current load requirements and limited gate drive current capabilities exist. Examples include ignition circuits, motor controls, and DC latching for alarms in smoke detectors. Sensitive gate SCRs are available in voltage ratings to 600 V ac.

## SCRs

Teccor's SCR products are half-wave, silicon-controlled rectifiers that represent the state of the art in design and performance.

Load current capabilities range from 1 A to 70 A rms, and voltages from 200 V to 1000 V may be specified to meet a variety of application needs.

Because of its unidirectional switching capability, the SCR is used in circuits where high surge currents or latching action is required. It may also be used for half-wave-type circuits where gate-controlled rectification action is required. Applications include crowbars in power supplies, camera flash units, smoke alarms, motor controls, battery chargers, and engine ignition.

Surge current ratings are available from 30 A in the TO-92 packaging to 950 A in the TO-218X package.

## Rectifiers

Teccor manufactures 15 A to 25 A rms rectifiers with voltages rated from 200 V to 1000 V. Due to the electrically isolated TO-220 package, these rectifiers may be used in common anode or common cathode circuits using only one part type, thereby simplifying stock requirements.

## Diacs

Diacs are trigger devices used in phase control circuits to provide gate pulses to a triac or SCR. They are voltage-triggered bidirectional silicon devices housed in DO-35 glass axial lead packages and DO-214 surface mount packages.

Diac voltage selections from 27 V to 45 V provide trigger pulses closely matched in symmetry at the positive and negative break-over points to minimize DC component in the load circuit.

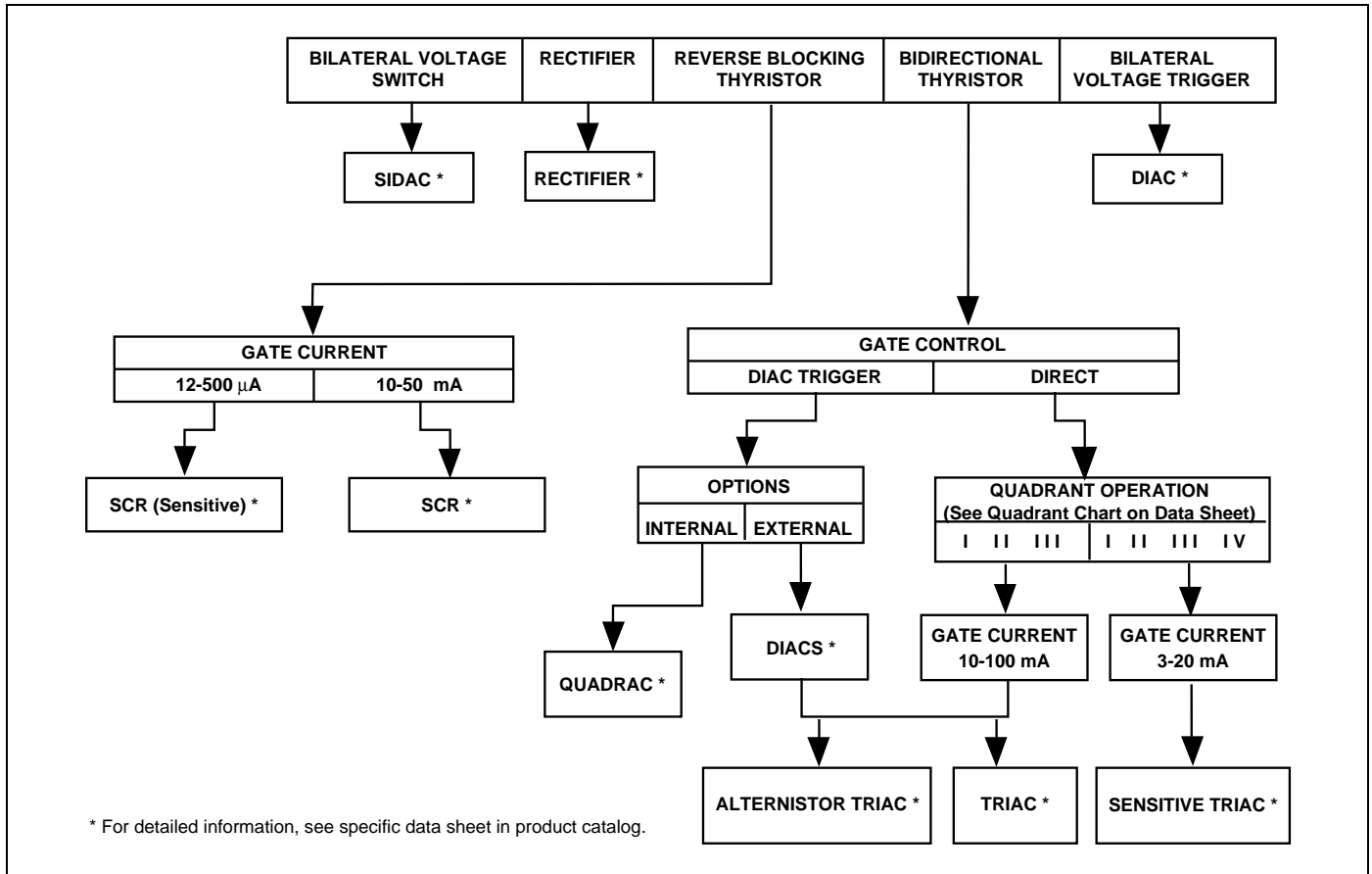
Some applications include gate triggers for light controls, dimmers, power pulse circuits, voltage references in AC power circuits, and triac triggers in motor speed controls.

## Sidacs






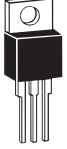
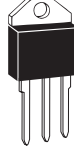

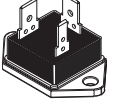
Sidacs represent a unique set of thyristor qualities. The sidac is a bidirectional voltage triggered switch. Some characteristics of this device include a normal 95 V to 330 V switching point, negative resistance range, latching characteristics at turn-on, and a low on-state voltage drop.

One-cycle surge current capability up to 20 A makes the sidac an ideal product for dumping charged capacitors through an inductor in order to generate high-voltage pulses. Applications include light controls, high-pressure sodium lamp starters, power oscillators, and high-voltage power supplies.

# Circuit Requirement Diagram


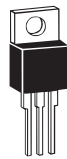
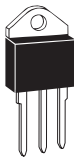
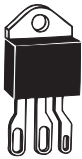
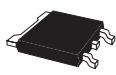

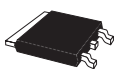


# Product Packages

Package Code							Isolated Mounting Tab			
		G	Y	S	C	E	L	K	J	P
Product Type	Current (Amps)									
		DO-15	DO-35	DO-214	Compak	TO-92 *	TO-220	TO-218	TO-218X	TO-3 Fastpak
Sensitive Triac	0.8				✓	✓				
	1				✓	✓				
	4						✓			
	6						✓			
	8						✓			
Triac	0.8				✓	✓				
	1				✓	✓				
	4						✓			
	6						✓			
	8						✓			
	10						✓			
	15						✓			
	25									✓
35									✓	
Quadrac	4						✓			
	6						✓			
	8						✓			
	10						✓			
	15						✓			
Alternistor	6						✓			
	8						✓			
	10						✓			
	12						✓			
	16						✓			
	25						✓	✓	✓	
	30						✓			
	35									
40							✓	✓		
Sensitive SCR	0.8				✓	✓				
	1.5					✓				
	4									
	6						✓			
	8						✓			
	10						✓			
SCR	1				✓	✓				
	6						✓			
	8						✓			
	10						✓			
	12						✓			
	15						✓			
	16									
	20						✓			
	25						✓			
	35							✓	✓	
	40									
55										
65							✓	✓		
70										
Rectifier	15						✓			
	20						✓			
	25						✓			
Diac			✓	✓						
Sidac		✓		✓			✓*			

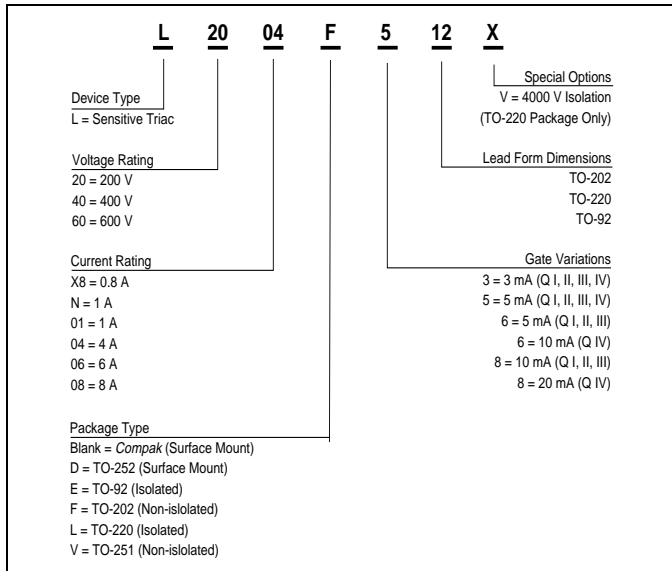
\* No center lead on TO-92 Sidacs.

# Product Packages

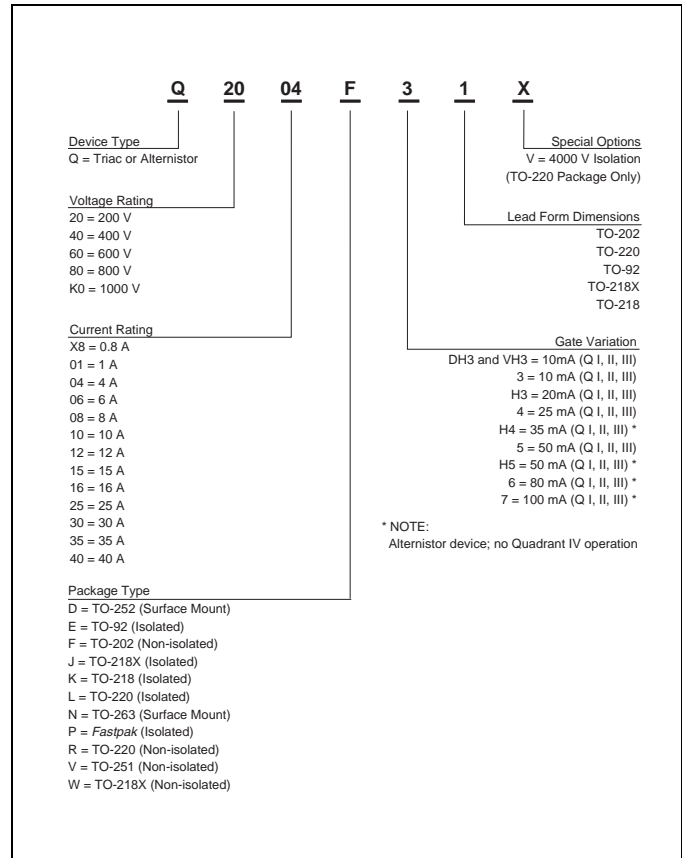
Non-isolated Mounting Tab							Package Code	
F	R	M	W	D	V	N	Current (Amps)	Product Type
 TO-202	 TO-220	 TO-218	 TO-218X	 TO-252 D-Pak	 TO-251 V-Pak	 TO-263 D²Pak		
							0.8	Sensitive Triac
							1	
✓				✓	✓		4	
				✓	✓		6	
				✓	✓		8	
							0.8	Triac
							1	
✓				✓	✓		4	
✓	✓					✓	6	
✓	✓					✓	8	
✓	✓					✓	10	
	✓					✓	15	
	✓					✓	25	
	✓					✓	35	
							4	
							6	Quadrac
							8	
							10	
							15	
							4	
	✓			✓	✓	✓	6	Alternistor
	✓			✓	✓	✓	8	
	✓					✓	10	
	✓					✓	12	
	✓					✓	16	
	✓					✓	25	
	✓					✓	30	
	✓					✓	35	
	✓					✓	40	
	✓						0.8	
	✓						1.5	
✓	✓			✓	✓		4	
✓	✓			✓	✓		6	
✓	✓			✓	✓		8	
✓	✓			✓	✓		10	
							1	SCR
✓				✓	✓		6	
✓	✓			✓	✓		8	
✓	✓			✓	✓		10	
	✓			✓	✓		12	
	✓						15	
	✓					✓	16	
	✓					✓	20	
	✓					✓	25	
	✓					✓	35	
	✓	✓	✓			✓	40	
	✓		✓			✓	55	
			✓				65	
			✓				70	
							15	Rectifier
							20	
							25	
✓								Diac
								Sidac

# Description of Part Numbers

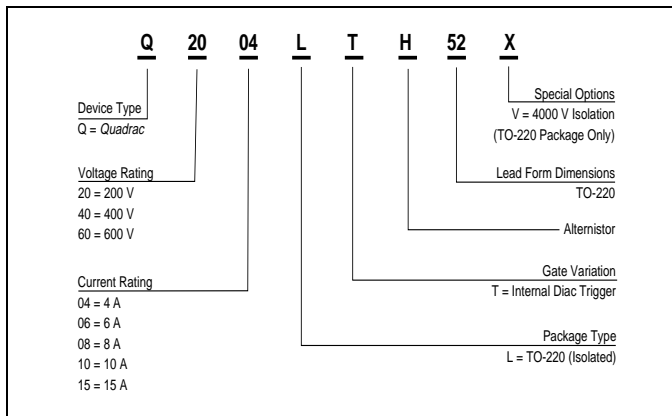
## Sensitive Triac



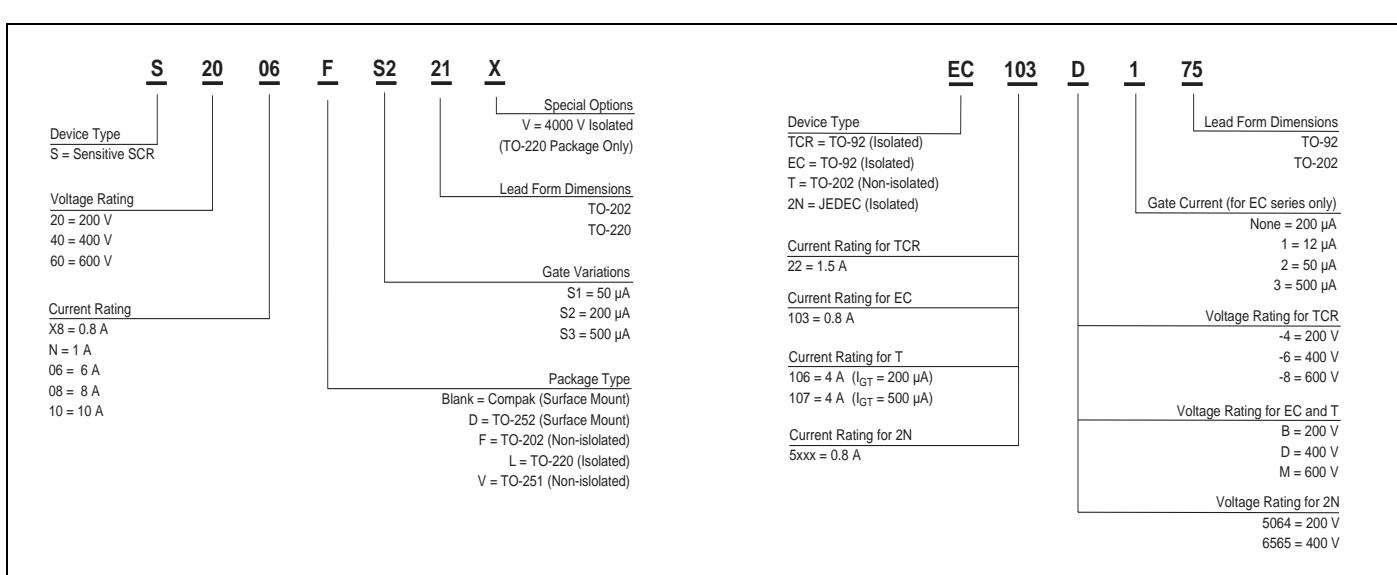
## Triac and Alternistor



## Quadrac

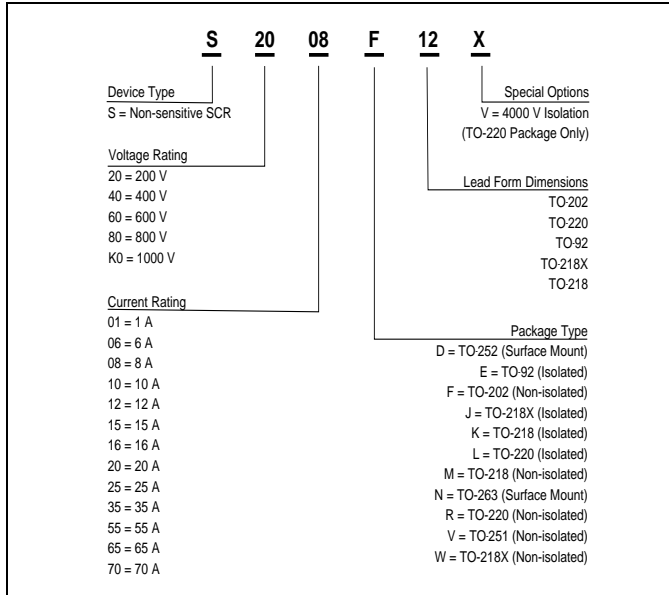


## Sensitive SCR

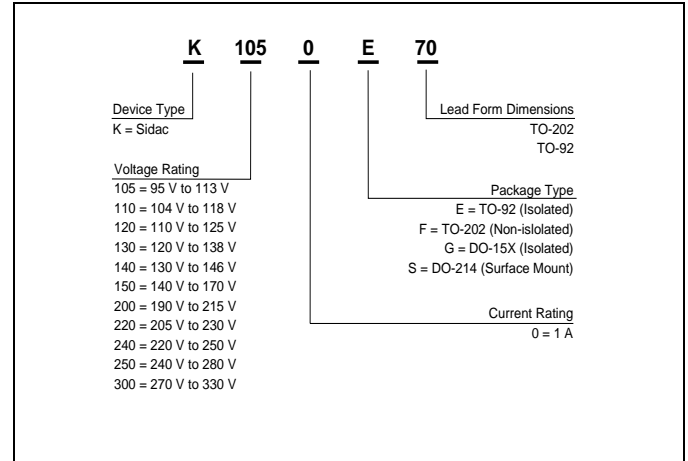


# Description of Part Numbers

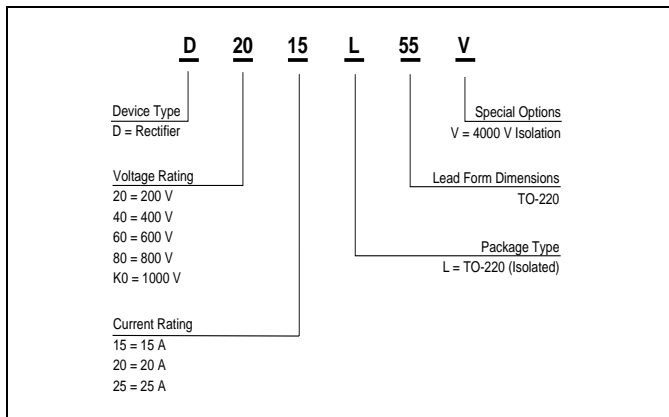
## SCR



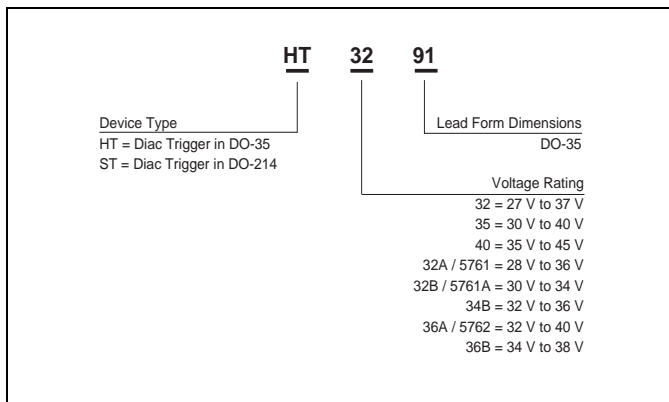
## Sidac



## Rectifier



## Diac



# Quality and Reliability

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It is Teccor's policy to ship quality products on time. We accomplish this through Total Quality Management based on the fundamentals of customer focus, continuous improvement, and people involvement.

In support of this commitment, Teccor applies the following principles:

- Employees shall be respected, involved, informed, and qualified for their job with appropriate education, training, and experience.
- Customer expectations shall be met or exceeded by consistently shipping products that meet the agreed specifications, quality levels, quantities, schedules, and test and reliability parameters.
- Suppliers shall be selected by considering quality, service, delivery, and cost of ownership.
- Design of products and processes will be driven by customer needs, reliability, and manufacturability.

It is the responsibility of management to incorporate these principles into policies and systems.

It is the responsibility of those in leadership roles to coach their people and to reinforce these principles.

It is the responsibility of each individual employee to follow the spirit of this statement to ensure that we meet the primary policy — to ship quality products on time.

## Quality Assurance

### Incoming Material Quality

Teccor "Vendor Analysis" programs provide stringent requirements before components are delivered to Teccor. In addition, purchased materials are tested rigidly at incoming inspection for specification compliance prior to acceptance for use.

### Process Controls

From silicon slice input through final testing, we use statistical methods to control all critical processes. Process audits and lot inspections are performed routinely at all stages of the manufacturing cycle.

### Parametric Testing

All devices are 100% computer tested for specific electrical characteristics at critical processing points.

### Final Inspection

Each completed manufacturing lot is sampled and tested for compliance with electrical and mechanical requirements.

### Reliability Testing

Random samples are taken from various product families for ongoing reliability testing.

### Finished Goods Inspection

Product assurance inspection is performed immediately prior to shipping.

## Design Assurance

The design and production of Teccor devices is a demanding and challenging task. Disciplined skills coupled with advanced computer-aided design, production techniques, and test equipment are essential elements in Teccor's ability to meet your demands for the very highest levels of quality.

All products must first undergo rigid quality design reviews and pass extensive environmental life testing. Teccor uses Statistical Process Control (SPC) with associated control charts throughout to monitor the manufacturing processes.

Only those products which pass tests designed to assure Teccor's high quality and reliability standards, while economically satisfying customer requirements, are approved for shipment. All new products and materials must receive approval of QRA prior to being released to production.

The combination of reliability testing, process controls, and lot tracking assures the quality and reliability of Teccor's devices. Since even the best control systems cannot overcome measurement limitations, Teccor designs and manufactures its own computerized test equipment.

Teccor's Reliability Engineering Group conducts ongoing product reliability testing to further confirm the design and manufacturing parameters.

## Reliability Stress Tests

The following table contains brief descriptions of the reliability tests commonly used in evaluating Teccor product reliability on a periodic basis. These tests are applied across product lines depending on product availability and test equipment capacities. Other tests may be performed when appropriate.

Test Type	Typical Conditions	Test Description	Standards
<b>High Temperature AC Blocking</b>	$T_A = 100\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$ , Bias @ 100% Rated $V_{\text{DRM}}$ , $t = 24\text{ hrs}$ to $1000\text{ hrs}$	Evaluation of the reliability of product under bias conditions and elevated temperature	MIL-STD-750, M-1040
<b>High Temperature Storage Life</b>	$T_A = 150\text{ }^{\circ}\text{C}$ , $t = 250$ to $1000\text{ hrs}$	Evaluation of the effects on devices after long periods of storage at high temperature	MIL-STD-750, M-1031
<b>Temperature and Humidity Bias Life</b>	$T_A = 85\text{ }^{\circ}\text{C}$ to $95\text{ }^{\circ}\text{C}$ , $rh = 85\%$ to $95\%$ Bias @ 80% Rated $V_{\text{DRM}}$ (320 VDC max) $t = 168$ to $1008\text{ hrs}$	Evaluation of the reliability of non-hermetic packaged devices in humid environments	EIA / JEDEC, JESD22-A101
<b>Temperature Cycle [Air to Air]</b>	$T_A = -65\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$ , cycles = $10$ to $500$	Evaluation of the device's ability to withstand the exposure to extreme temperatures and the forces of TCE during transitions between temperatures	MIL-STD-750, M-1051, EIA / JEDEC, JESD22-A104
<b>Thermal Shock [Liquid to Liquid]</b>	$T_A = 0\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ , $t_{\text{txfr}} = \leq 10\text{ s}$ , cycled = $10$ to $20$	Evaluation of the device's ability to withstand the sudden changes in temperature and exposure to extreme temperatures	MIL-STD-750, M-1056
<b>Autoclave</b>	$T_A = 121\text{ }^{\circ}\text{C}$ , $rh = 100\%$ , $P = 15\text{ psig}$ , $t = 24\text{ hrs}$ to $168\text{ hrs}$	Accelerated environmental test to evaluate the moisture resistance of plastic packages	EIA / JEDEC, JESD22-A102
<b>Resistance to Solder Heat</b>	$T_A = 260\text{ }^{\circ}\text{C}$ , $t = 10\text{ s}$	Evaluation of the device's ability to withstand the temperatures as seen in wave soldering operations	MIL-STD-750, M-2031
<b>Solderability</b>	Steam aging = $1\text{ hr}$ to $8\text{ hrs}$ , $T_{\text{solder}} = 245\text{ }^{\circ}\text{C}$ , Flux = R	Evaluation of the solderability of device terminals after an extended period	MIL-STD-750, M-2026, ANSI-J-STD-002

## Flammability Test

For the UL 94V0 flammability test, all epoxies used in Teccor encapsulated devices are recognized by Underwriters Laboratories

# Standard Terms and Conditions

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Supplier shall not be bound by any term proposed by Buyer in the absence of written agreement to such term signed by an authorized officer of Supplier.

(1) PRICE:

- (A) Supplier reserves the right to change product prices at any time but, whenever practicable, Supplier will give Buyer at least thirty (30) days written notice before the effective date of any price change. Unless Supplier has specifically agreed in writing, signed by an authorized officer of Supplier, that a quoted price shall not be subject to change for a certain time, all products shipped on or after the effective date of a price change may be billed at the new price level.
- (B) Whenever Supplier agrees to a modification of Buyer's order (which modification must be in writing and signed by an authorized officer of Supplier), Supplier reserves the right to alter its price, whether or not such price was quoted as "firm."
- (C) Prices do not include federal, state or local taxes, now or hereafter enacted, applicable to the goods sold. Taxes will be added by Supplier to the sales prices whenever Supplier has legal obligation to collect them and will be paid by Buyer as invoiced unless Buyer provides Supplier with a proper tax exemption certificate.

(2) PRODUCTION: Supplier may, at its sole discretion and at any time, withdraw any catalog item from further production without notice or liability to Buyer.

(3) INTEREST:

- (A) All late payments shall bear interest thirty (30) days after the due date stated on the invoice until paid at the lower of one and one-half percent per month or the maximum rate permitted by law. All interest becoming due shall, if not paid when due, be added to principal and bear interest from the due date. At Supplier's option, any payment shall be applied first to interest and then to principal.
- (B) It is the intention of the parties to comply with the laws of the jurisdiction governing any agreement between the parties relating to interest. If any construction of the agreement between the parties indicates a different right given to Supplier to demand or receive any sum greater than that permissible by law as interest, such as a mistake in calculation or wording, this paragraph shall override. In any contingency which will cause the interest paid or agreed to be paid to exceed the maximum rate permitted by law, such excess will be applied to the reduction of any principal amount due, or if there is no principal amount due, shall be refunded.

(4) TITLE AND DELIVERY: Title to goods ordered by Buyer and risk of loss or damage in transit or thereafter shall pass to Buyer upon Supplier's delivery of the goods at Supplier's plant or to a common carrier for shipment to Buyer.

(5) CONTINGENCIES: Supplier shall not be responsible for any failure to perform due to causes reasonably beyond its control. These causes shall include, but not be restricted to, fire, storm, flood, earthquake, explosion, accident, acts of public enemy, war rebellion, insurrection, sabotage, epidemic, quarantine restrictions, labor disputes, labor shortages, labor slow downs and sit downs, transportation embargoes, failure or delays in transportation, inability to secure raw materials or machinery for the manufacture of its devices, acts of God, acts of the Federal Government or any agency thereof, acts of any state or local government or agency thereof, and judicial action. Similar causes shall excuse Buyer for failure to take goods ordered by Buyer, from the time Supplier receives written notice from Buyer and for as long as the disabling cause continues, other than for goods already in transit or specially fabricated and not readily saleable to other buyers.

Supplier assumes no responsibility for any tools, dies, and other equipment furnished Supplier by Buyer.

(6) LIMITED WARRANTY AND EXCLUSIVE REMEDY: Supplier warrants all catalog products to be free from defects in materials and workmanship under normal and proper use and application for a period of twelve (12) months from the date code on the product in question (or if none, from the date of delivery to Buyer.) With respect to products assembled, prepared, or manufactured to Buyer's specifications, Supplier warrants only that such products will meet Buyer's specifications upon delivery. As the party responsible for the specifications, Buyer shall be responsible for testing and inspecting the products for adherence to specifications, and Supplier shall have no liability in the absence of such testing and inspection or if the product passes such testing or inspection. THE ABOVE WARRANTY IS THE ONLY WARRANTY EXTENDED BY SUPPLIER, AND IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES AND CONDITIONS, EXPRESSED OR IMPLIED (EXCEPT AS PROVIDED HEREIN AS TO TITLE), ON ANY GOODS OR SERVICES SOLD OR RENDERED BY SUPPLIER, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY WILL NOT CREATE WARRANTY COVERAGE FOR ANY ITEM INTO WHICH ANY PRODUCT SOLD BY SUPPLIER MAY HAVE BEEN INCORPORATED OR ADDED.

# Standard Terms and Conditions

SUPPLIER'S ENTIRE LIABILITY AND BUYER'S EXCLUSIVE REMEDY UNDER THIS WARRANTY SHALL BE, AT SUPPLIER'S OPTION, EITHER THE REPLACEMENT OF, REPAIR OF, OR ISSUANCE OF CREDIT TO BUYER'S ACCOUNT WITH SUPPLIER FOR ANY PRODUCTS WHICH ARE PROPERLY RETURNED BY BUYER DURING THE WARRANTY PERIOD. All returns must comply with the following conditions:

- (A) Supplier is to be promptly notified in writing upon discovery of defects by Buyer.
- (B) Buyer must obtain a Return Material Authorization (RMA) number from the Supplier prior to returning product.
- (C) The defective product is returned to Supplier, transportation charges prepaid by Buyer.
- (D) Supplier's examination of such product discloses, to its satisfaction, that such defects have not been caused by misuse, neglect, improper installation, repair, alteration, or accident.
- (E) The product is returned in the form it was delivered with any necessary disassembly carried out by Buyer at Buyer's expense.

IN NO EVENT SHALL SUPPLIER, OR ANYONE ELSE ASSOCIATED IN THE CREATION OF ANY OF SUPPLIER'S PRODUCTS OR SERVICES, BE LIABLE TO BUYER FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE INCLUDING LOSS OF PROFITS, LOSS OF USE, BUSINESS INTERRUPTION, AND THE LIKE. BUYER ACKNOWLEDGES THAT THE ABOVE WARRANTIES AND LIMITATIONS THEREON ARE APPROPRIATE AND REASONABLE IN EFFECTUATING SUPPLIER'S AND BUYER'S MUTUAL INTENTION TO CONDUCT AN EFFICIENT TRANSACTION AT PRICES MORE ADVANTAGEOUS TO BUYER THAN WOULD BE AVAILABLE IN THE PRESENCE OF OTHER WARRANTIES AND ASSURANCES.

- (7) PATENTS: Buyer shall notify Supplier in writing of any claim that any product or any part of use thereof furnished under this agreement constitutes an infringement of any U.S. patent, copyright, trade secret, or other proprietary rights of a third party. Notice shall be given within a reasonable period of time which should in most cases be within ten (10) days of receipt by Buyer of any letter, summons, or complaint pertaining to such a claim. At its option, Supplier may defend at its expense any action brought against Buyer to the extent that it is based on such a claim. Should Supplier choose to defend any such claim, Supplier may fully participate in the defense, settlement, or appeal of any action based on such claim.

Should any product become, or in Supplier's opinion be likely to become, the subject of an action based on any such claim, Supplier may, at its option, as the Buyer's exclusive remedy, either procure for the Buyer the right to continue using the product, replace the product or modify the product to make it noninfringing. IN NO EVENT SHALL SUPPLIER BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES BASED ON ANY CLAIM OF INFRINGEMENT.

Supplier shall have no liability for any claim based on modifications of a product made by any person or entity other than Supplier, or based on use of a product in conjunction with any other item, unless expressly approved by Supplier. Supplier does not warrant goods against claims of infringement which are assembled, prepared, or manufactured to Buyer's specifications.

- (8) NON-WAIVER OF DEFAULT: Each shipment made under any order shall be treated as a separate transaction, but in the event of any default by Buyer, Supplier may decline to make further shipments without in any way affecting its rights under such order. If, despite any default by Buyer, Supplier elects to continue to make shipments, its action shall not constitute a waiver of that or any default by Buyer or in any way affect Supplier's legal remedies for any such default. At any time, Supplier's failure to exercise any right to remedy available to it shall not constitute a waiver of that right or remedy.

- (9) TERMINATION: If the products to be furnished under this order are to be used in the performance of a Government contract or subcontract, and the Government terminates such contract in whole or part, this order may be canceled to the extent it was to be used in the canceled portion of said Government contract and the liability of Buyer for termination allowances shall be determined by the then applicable regulations of the Government regarding termination of contracts. Supplier may cancel any unfilled orders unless Buyer shall, upon written notice, immediately pay for all goods delivered or shall pay in advance for all goods ordered but not delivered, or both, at Supplier's option.

- (10) LAW: The validity, performance and construction of these terms and conditions and any sale made hereunder shall be governed by the laws of the state of Texas.

- (11) ASSIGNS: This agreement shall not be assignable by either Supplier or Buyer. However, should either Supplier or Buyer be sold or transferred in its entirety and as an ongoing business, or should Supplier or Buyer sell or transfer in its entirety and as an ongoing concern, any division, department, or subsidiary responsible in whole or in part for the performance of this Agreement, this Agreement shall be binding upon and inure to the benefit of those successors and assigns of Supplier, Buyer, or such division, department, or subsidiary.

- (12) MODIFICATION OF STANDARD TERMS AND CONDITIONS: No attempted or suggested modification of or addition to any of the provisions upon the face or reverse of this form, whether contained or arising in correspondence and/or documents passing between Supplier and Buyer, in any course of dealing between Supplier or Buyer, or in any customary usage prevalent among businesses comparable to those of Supplier and/or Buyer, shall be binding upon Supplier unless made and agreed to in writing and signed by an officer of Supplier.

- (13) QUANTITIES: Any variation in quantities of electronic components, or other goods shipped over or under the quantities ordered (not to exceed 5%) shall constitute compliance with Buyer's order and the unit price will continue to apply.

# Notes

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