TEK COMPANY CONFIDENTIAL

ISSUE 292
NOV. 9, 1981

component news

DIN connector gaining popularity

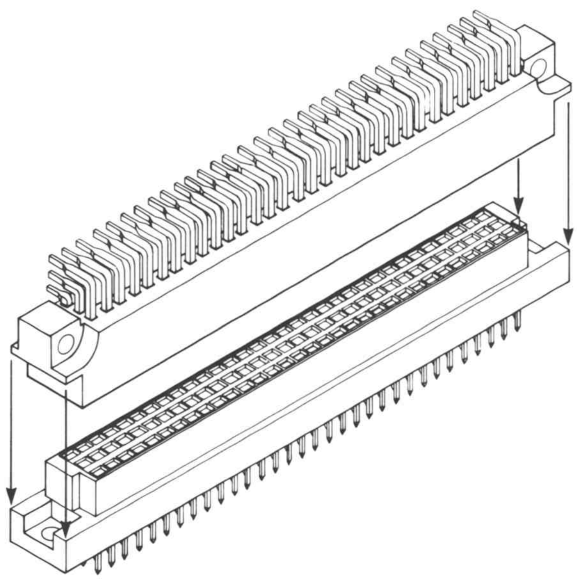
Throughout the domestic marketplace the DIN, or Eurocard, connector has received increasing attention. This European, two-piece PCB connector system was developed in accordance with a DIN specification which tightly controls external dimensions and footprints.

The DIN system has functioned as a standard European instrument interface and as a mother/daughter board interconnect for about 10 years. Outside Europe, the choice was made to utilize edgecard connectors as the standard PCB system. It is becoming increasingly clear, however, that edgecard connectors are not sufficiently reliable in providing a stable contact for "low level" signals. This realization has led to an interest in two-piece PCB conectors.

Centered upon the popular 0.025" square post, the male DINs are housed in a fully shrouded, universally polarized header of two or three rows, 32 positions each (see illustration). A chamfered lead-in on the housing assures self-centering for up to five degrees of misalignment. By selective loading, any number of circuits up to 96 are available.

The female sockets are fully enclosed in plastic, which effectively protects them from damage. Because the spec governs performance and dimensions only, a variety of plating schemes is available, such as selective gold (20, 30, 50 and 80 microinch) with tin-plated tails.

Mounting for the socket (as well as the header) is accomplished by bolting to the PCB through a hole in the mounting ears. This arrangement is effective in controlling board warpage during flow soldering.



Because the pin-out for this system is on a 0.100" grid, multilayer boards are necessary to access all the tails on the three-row version. A full entourage of tail styles including wire wrap and right-angle is available — the standard configuration being right-angle solder tails on the header and straight solder tails on the socket.

continued on page 2

ALSO IN THIS ISSUE

Evaluation results

After evaluation, it was apparent that several characteristics contributed to this connector's reputation for good performance. The average edgecard connector must tolerate a mate (the PCB) with a thickness variation of up to 0.014". Compounding the problem, board warpage for larger boards can cause the contact spring to see an "effective board thickness" variation of up to 0.032". Under these conditions spring normal forces can range from 80 to 400 grams.

Because the tolerance on a typical 0.025" square pin is ±0.002", the DIN connector spring can be designed to operate over a much narrower deflection range. Accounting for misalignment, etc., each position sees an "effective pin" tolerance of about ±0.004". Normal forces have been measured in the 100 to 200 gram range, depending upon spring design.

Despite rolling and beveling, the leading edge of the PCB is a very abrasive combination of glass fibers, epoxy and rough metal surfaces. This, of course, leads to high levels of wear in the nose of the spring. Although the most severe wear occurs just out of the spring's contact area, corrosion products originating at the exposed copper on the spring can migrate over the surface and enter the contact region, leading to unstable or high contact resistance.

The advantage with the DIN system is that the mating pins are chamfered to present a less abrasive surface to the springs, thereby reducing plating wear. A typical edgecard connector will wear through to base material after about 600 to 700 cycles, whereas after 1000 cycles no exposed copper was observed in the DIN contacts.

Studies have revealed the effectiveness of environmental shielding in reducing the reaction rates between connector systems and atmospheric pollutants. Because both the headers and sockets are fully shrouded, the DIN connector exhibits good shielding characteristics. Edgecard connectors, on the other hand, are one of the most exposed (unshielded) systems available for board interconnects.

Disadvantages of the DIN system

There are some disadvantages associated with this system. Some socket designs have closed bottoms which do not allow flux wash solution to drain from the socket cavity. This may lead to contamination of the contact area, eventually promoting intermittents. A scrupulous examination of sockets, however, will clearly reveal whether such a problem will occur.

Because the headers lie flush with the bottom of the board, the plastic is in direct contact with the solder wave during flowsoldering. Some companies have chosen a plastic which will not permit flowsoldering without using some type of protective shield. However, there are headers available which will withstand such treatment.

At this time, the DIN is only available through the European division of domestic companies. Consequently, leadtimes are around 14 weeks and prices are higher than they need to be. For example, a 96-pin socket costs between $10 and $20, and a 96-pin header ranges in price from $6 to $10. In comparison, a typical edgecard connector might cost about $8 to $10 for an equivalent pin-out. The cost of gold fingers (not needed for the DINs) might approach $10.(1) Thus, for 96 circuits the DIN connector might be competitive in price to the edgecard connector system. For less than 96 positions, though, the DIN seems to generally run higher in price.

At least two manufacturers are in the process of tooling this part for domestic production. When available, both leadtimes and prices should decrease. These should be available about mid-1982.

In the past year there has been much activity in the production of standards pertaining to this system. The DIN, IEEE and MIL specs which have been developed were designed to ensure intermatability between vendors. Thus, the header from vendor "A" mates with the socket of vendor "B", thereby ensuring multiple sources. Also, IEEE has been considering the DIN as a standard backplane interface. TRW LSI Products is using this connector on an A/D converter; Siemens has utilized it in an 8086-based microprocessor board; other examples are prevalent in the trade magazines.

For more information or evaluation results, please contact **Joe Reshey, ext. BDR-2313.**

(1)This is based on a price-per-finger of 10¢. The actual gold pad cost for a given board varies widely and may have a significant impact on total connector system price. Cost of plated holes likewise varies but usually is below 1¢ per hole for production boards.

8048-family programmer/reader board (for bucket)

The Intel 8048 family is a group of about ten single-chip microcomputers. Each member of the family contains different amounts of onboard RAM and program memory. The program memory can be either ROM or EPROM.

The ability to read and program the internal program memory is essential for evaluating and using these components. While some development systems with this capability are commercially available, they have two disadvantages — they are expensive, and they are inflexible for varying conditions such as programming pulse width (e.g., data retention studies).

A test board that meets our needs, yet still can be of general use to Tek, has been designed for use in the board bucket systems. The CSC (Computer Science Center) Microprocessor Support Group has laid out the board, and it is available as board number E8227.

General description

The E8227 board can be set up to run in any of the board bucket systems, but the firmware (or software) is only written for the 6800 or 6809 microprocessors. While it may seem strange to have an Intel microcomputer controlled by a Motorola microprocessor, the board is merely programming or reading the 8048 memory (the 8048 CPU is not running). Also, the majority of the board bucket systems are based on the 6800 or 6809.

The 8227 board hardware is flexible; the control PIAs (peripheral interface adapters) and the optional EPROM (2716 or 2732) can be selected by address straps to reside at any portion of the system memory map. The 25 volts needed for programming is generated on board from the 15 volt supply.

The E8227 board firmware is interactive, and leads the user through each operation by prompting with questions printed on the computer terminal. Some extra "bells and whistles" were included, such as checking for misinserted (backwards) components and allowing repetitive "program" or "read" operations.

Applications

As examples, here are three possible applications for the board.

Stand-alone bucket — An application that would fit well into a minimum environment is an incoming-inspection type of operation. Using a board bucket containing a 6809 single board computer or SBC (E8069) and the new programmer/reader board (E8227), the internal memory of the microcomputers could be verified as quickly as the parts could be plugged into the ZIF (zero insertion force) socket. The code to be compared would have to be in an EPROM on either board if it exceeds the 1K-byte of RAM on the 6809 SBC. Programming could also be done in this manner, but it takes up to a couple of minutes per part.

Bucket and CYBER — This is a combination that works well for simple development and prototype support. A basic bucket system like the one described earlier could be used; in addition, some RAM (e.g., the E7599 64K-byte board) and a CYBER link is necessary. An editor such as SCRIBE can be used to create a source file. Other microprocessor development tools on the CYBER allow you to compile or assemble and download the object code to the board bucket. Verifying or programming can then be done independent of the CYBER using the E8227 board.

Disk-based bucket — Adding an E7901 disk controller board and a 5-inch floppy disk drive (two disk drives are almost a necessity) allows the use of FLEX 09, a disk operating system for the 6809 (see *Component News 288* for a description of this operating system). A weak link exists in this setup, because I am not aware of an 8048 cross assembler that will run with FLEX 09. There are 8048 assemblers available for use with the CP/M 2.2 operating system, but the CP/M system works with 8085/Z80 processors — rather than the 6809. Unless CPU boards and operating systems are swapped, a cross assembler becomes available, or independent systems with transfer capabilities are acceptable, the CYBER will still have to be used to assemble the uploaded source file.

Note: The "hooks" have been included on this board to allow programming other devices (such as the next generation 8051 family) with the addition of an adapter board to match the pinouts.

If you have any questions or need information, please contact **Ken Smith, Digital Component Engineering, ext. BDR-2319**; or **Ferrous Steinka, Computer Science Center, ext. WR-1920**.

Comparing the leading floppy disk controllers

Software Commands

NEC765	WD1791/3
1. RECALIBRATE (77 step pulses. Simultaneously seeks on MULTIPLE drives. See HARDWARE, POLLING)	1. RECALIBRATE (255 step pulses)
2. SEEK	2. SEEK (Verifies track address) STEP STEP IN STEP OUT
3. READ DATA (Multi-sector/multi-track)	3. READ SECTOR (Multi-record)
4. READ DELETED DATA	4. READ SECTOR (Status BIT 5 = 1 for deleted DATA AM)
5. WRITE DATA	5. WRITE SECTOR
6. WRITE DELETED DATA	6. WRITE SECTOR (Deleted DATA AM — CMD BIT 0 set = 1)
7. READ ID	7. READ ADDRESS
8. READ TRACK (Only data fields transferred. CRC flagged in status)	8. READ TRACK (All gaps, AM ID fields and DATA fields transferred — no CRC check)
9. FORMAT TRACK (Four bytes/sector transferred — C, H, R, N. Date field is filled by a pre-specified 8-bit pattern. For one track using 256-byte sectors MFM, 104 bytes of memory is required for data)	9. WRITE TRACK (All gaps, AM and DATA must be transferred from memory. For one track using 256-byte sectors MFM, 10,364 bytes of memory are required for data)
10. See HARDWARE, TERMINAL COUNT	10. FORCE INTERRUPT (Used to terminate data transfer on non-sector boundaries)
11. SCAN EQUAL SCAN LOW OR EQUAL SCAN HIGH OR EQUAL (Compares FD data to memory on the fly)	

continued on page 5

NEC765

WD1791/3

12. SENSE INTERRUPT

    (Required after seek, recalibrate)

13. SPECIFY

    (Required to set up drive, format related data)

14. SENSE DRIVE STATUS

15. INVALID

    (Invalid commands/noop)

Sector Sizes Supported

NEC765

1. MFM — 256, 512, 1024, 2048, 4096, 8192

   FM — 128, 256, 512, 1024, 2048, 4096

WD1791/3

1. MFM, FM — 128, 256, 512, 1024

DC Parametric

NEC765

1. +5V ±5%
2. −10°C — 70°C
3. 1.0W
4. V_{IH} = 2.0 minimum
5. V_{IL} = 0.8 maximum
6. V_{OH} = 2.4 @ 200μA minimum
7. V_{OL} = 0.45 @ 2.0mA maximum

WD1791/3

1. +5 ±5%, +12V ±5%
2. 0°C — 70°C
3. 0.5W
4. V_{IH} = 2.6 minimum
5. V_{IL} = 0.8 maximum
6. V_{OH} = 2.8 @ 100μA minimum
7. V_{OL} = 0.45 @ 1.6mA maximum

Second Sources

NEC765

1. Intel 8272 (Tek P/N 156-1412-00)

WD1791/3

1. Siemans SAB 1791/3
2. Synertek SY1791-02/SY1793-02
3. Fujitsu MB8866, MB8876, MB8877 (not plug compatible)

continued on page 6

Hardware

NEC765

1. POLLING

   (Requires step motor to be continuously enabled or external circuitry to effectively utilize this function — **not optional**)

2. HEAD LOAD TIMING

   (Programmable)

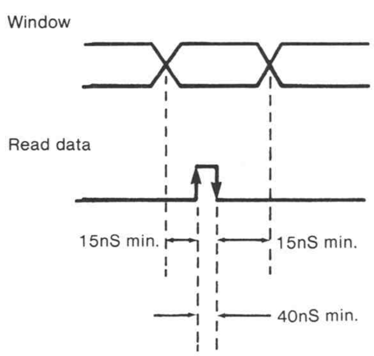
3. TERMINAL COUNT (Pin)

   (Provides a hardware control to terminate data transfer)

4. STEP RATE

   (Programmable, 1 - 16mS, in increments of 1mS with 8MHz clock)

5. READ DATA TIMING



WD1791/3

2. HEAD LOAD TIMING

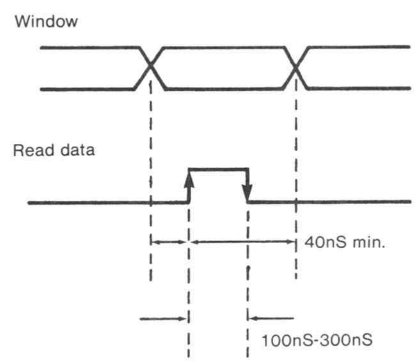
   (Requires **external** delay, one shot)

3. See FORCED INTERRUPT

4. STEP RATE

   (Programmable, 3mS, 6mS, 10mS and 15mS with 2MHz clock)

5. READ DATA TIMING



Read Data Separator

NEC765

WD1791/3

1. RG (Pin)

   RG is used to inform PLL when to acquire synchronization. The 1791/3 activates RG after two bytes of zeros are detected. The Data Address mark **must** be found in the next 10 bytes.

continued on page 7

NEC765

2. VCO SYNC (Pin)

Active when reading ID field. Goes inactive after CRC is read. Goes active four bytes (FM), eight bytes (MFM), before data AM.

WD1791/3

2. VFOE (Pin)

VFOE pin is used for PLL synchronization. It is active when the head is loaded, settling time has expired and the 1791/3 is inspecting data off the disk.

Note: RG on 1791/1793 was replaced with a side **select** on 1795/1797. VFOE on 1795/1797 remains inactive after the ID CRC field is read and until eight bytes (MFM) or four bytes (FM) before the Data Address mark. The 1791/3 is more tolerant in finding DATA AM than WD1795/7 or NEC765.

If you have any questions, or for more information, please contact **Pat Emmons, ext. BDR-2009.**

Bar code standard adopted

Representatives of the four divisions, EMCM, Technology Group and Corporate Distribution have agreed to a bar code standard for Tektronix. The standard (Tek Standard #062-6344-00) is as follows:

Code type:	Code 39
"X" factor:	0.0075" **minimum** size
Format:	Machine readable/ man readable

CODE 39

This bar code standard is already used in three applications at Walker Road.

The purpose of this standard is to assure that the company can get maximum benefit from bar-coded information by assuring that all groups can read all Tek-generated bar codes. This will be extremely important in MAS II applications.

If you have questions, contact **Merlyn Webster (ext. BDR-2635)**, or **Dwight Sigworth (ext. BDR-2710)**.

Update drawing if a part's status changes

If the status of a part changes from *Tek-made* per Tek drawing to *purchased* per Tek drawing, it requires that the Tek drawing be updated to show the correct information.

Please refer to page 16 of 062-1708-00 Rev B, Note 9.17:

> 9.17 DRAWING PREPARATION — ITEMS MANUFACTURED FOR TEKTRONIX.
>
> "When a drawing is made of an item which is to be secured as a single part (or a single assembly) from an outside manufacturer to Tek specifications, the item shall be identified by a single part number. If it is an assembly, it should be drawn as an assembled item, with appropriate identification for its subparts, which may be separately detailed on the same sheet as the assembly or on additional sheets."

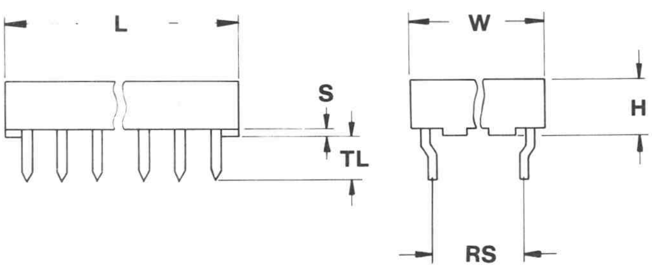
If you have any questions about this procedure, please contact **Dorothy Peterson, ext. BDR-2585.**

Reliable IC sockets

Some design groups may not be aware that a full line of highly reliable IC sockets is part numbered at Tek. I will quickly emphasize that the preferred method for addressing ICs is through direct solder connections to the board; however, if socketing is absolutely necessary, then a Burndy connector is the obvious choice over the gold inlay TI socket.

The Texas Instruments products have two basic problems — mechanical spring damage and unstable contact resistance. The former results from IC legs which are bent or have sharp edges. Consequently spring crushing, overstressing, etc. are fairly common phenomena in the production line. Because the TI socket is designed to mate with gold-plated IC leads, a connection to tin-plated legs will rapidly deteriorate, whether or not spring damage has occured.

The Burndy design is tin/lead-plated and provides sufficient spring force to break through tin oxide films present on the surfaces to be mated. Furthermore, the high forces help prevent relative motion between the spring and IC lead during vibration or temperature cycling. This alleviates the most common modes inducing fretting corrosion. Four years of experience with the Burndy socket have been accumulated at Tek, with extremely low reported failure rates.



Dimension	Texas Instruments	Burndy
Length	0.100" X no. positions ±0.015"	0.100" X no. positions max.
Height	0.150" max.	0.175" max.
Width (max.)	0.4/0.5/0.7"	0.4/0.5/0.7"
Tail length	0.140" ±0.010"	0.130" ±0.010"
Row spacing	0.3/0.4/0.6" ±0.005"	0.3/0.4/0.6" ±0.010"
Standoff	0.015"	0.027"

Figure 1 — Comparison of dimensions between TI and Burndy sockets

Figure 1 shows that there are only subtle dimensional differences between the two packages. However, the Burndy socket does provide higher unmate forces. For a cross reference of part numbers, consult Figure 2.

Number of positions	Texas Instruments	Burndy
8	136-0514-00	136-0727-00
14	136-0269-02	136-0728-00
16	136-0260-02	136-0729-00
18	136-0670-00	136-0756-00
20	136-0634-00	136-0752-00
22	136-0621-00	136-0754-00
24	136-0578-00	136-0751-00
28	136-0694-00	136-0755-00
40	136-0623-00	136-0757-00

Figure 2 — Cross reference between TI and Burndy (preferred) IC sockets

For more information, please contact me on ext. BDR-2313.

Joe Reshey
Electromechanical Comp. Eng.

Characterization test report

Voice data input terminal

We have completed a series of characterization tests on Threshold Technology Corporation's T500 Voice Data Entry Terminal (see *Component News 287*, page 11).

The basic conclusion is that it does quite well at recognizing vowel sounds, but has some trouble with the consonants. You can significantly improve performance by judicious choice of your command vocabulary. The report also discusses chip sets and single board devices becoming available for speech recognition.

For a copy of the report, contact **Jim Deer, ext. BDR-2484.**

Basics of step motor system design

A step motor is an electromechanical device that transforms electrical pulses into fixed mechanical movements. Conventional motors rotate continuously when energized; a step motor, when pulsed, rotates (or steps) in fixed angular increments.

The step angle produced by a step motor is determined by construction of the motor and the type of control system used. Available step angles vary from a fraction of a degree to 90 degrees, with the most popular range from 1.8 degrees to 15 degrees.

When a step motor is incremented, the step angle can be repeated accurately with each step of the motor. Common step accuracies vary from 1 to 5 percent of the step angle. This positional error is noncumulative regardless of the number of steps moved.

A step motor should be considered for a specific positioning control application if one or more of the following conditions exist:

1. A computer or digital control is implemented for an incremental motion system.
2. Accurate positioning is required.
3. Repetitive start/stop types of motion are required at a high rate of speed.
4. Holding torque or detent torque is required at rest.

A typical step motor positioning system consists of three major subsystems:

1. The motor and load system.
2. A power switching system that transforms input signals into DC power for the phase windings. This system is called the drive or power driver section, or translator.
3. A logic and control system that generates the necessary pulse sequences to provide input to the translator.

Each subsystem plays a major role in the successful operation of the positioning system as a whole, and each subsystem must be carefully matched to the capabilities of the other two subsystems.

Motor and load system

The mechanical structure of a step motor consists of a toothed rotor and stator with multiple phase windings. The number of rotor teeth, stator teeth and phase windings combine to determine the step angle of the motor.

To energize a step motor, DC power is applied to the phase windings. When the windings are switched sequentially, the rotor moves in step increments to align its teeth with the stator teeth of the energized phase. This generates a torque that varies with position and is symmetrical with respect to the rotor teeth. The magnitude of the torque depends on the structure of the motor and current in the phase windings.

In order to select a step motor for a specific positioning system, several factors such as load inertia, load friction, torque requirements for acceleration and deceleration, and the power and control available must be considered.

Translator

The translator performs the function of energizing and de-energizing the phase windings. Because motor torque is directly related to the phase currents, it is important that this current build up and decay rapidly. This is accomplished by applying a higher than normal voltage to the windings to increase the rate of current rise. Some external means is then used to limit the final current in the winding to its rated value.

Several over-excitation techniques are used: series resistance limiting drive, chopper drive, dual voltage or two-level drive, or variable voltage drive.

Series resistance limiting drive — With this technique, additional series resistance is used to limit the current to its rated value (see Figure 1, next page). For example, if we add a series resistance equal to three times the winding resistance, four times the rated voltage can be used, and the electrical time constant is reduced to one quarter of its original value.

The advantage of this technique is its simplicity and flexibility because a different series resistance can be used depending on the performance required.

The disadvantages of this technique are the excess power dissipated in the series resistors, and the limited voltage available to the motor itself. The result is a less efficient system and the need for a larger power supply.

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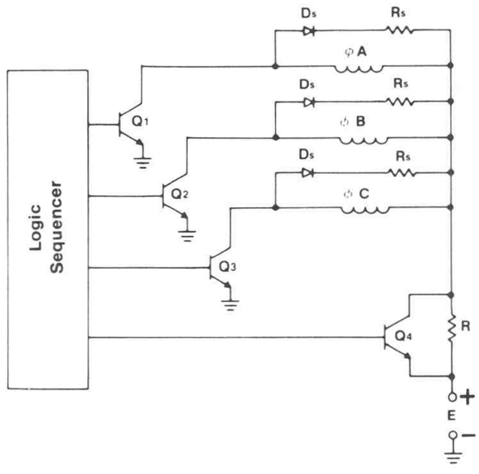

Figure 1 — Simplified series resistor driver with a transistor Q4 to shunt the current limiting resistor (R) during high speed slew. This results in higher speed and torque.

Chopper drive — This technique uses high voltage to produce a fast current rise without the use of additional resistance. Current limiting is provided by removing the supply voltage after a predetermined time, or when a predetermined current level is reached. Then the current is allowed to decay and the voltage is re-established at a predetermined point, and the cycle repeats itself until the phase is switched off (see Figure 2).

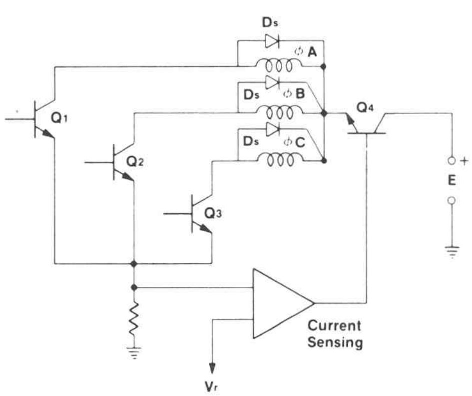

Figure 2 — Simplified chopper driver.

This technique of switching the voltage on and off maintains a constant current in the energized windings. When a new phase is switched on the whole process repeats itself. As the motor speed increases, the need to chop the current is reduced until the phases are being switched faster than the time it takes for current to rise to its rated value. At this speed and higher there is no need to chop the current during a step.

The advantage of chopper drive results from its efficient non-dissipative nature. Because input power requirement is equal to the motor power plus some drive losses, and all available voltage is supplied to the motor windings at all times, the drive is more compact.

The disadvantage is the increased complexity of the drive circuitry and associated reliability problems due to the extra switching functions. Also, if the chopping frequency is not high enough, audio noise can be produced when the motor is at rest.

Dual voltage or two-level drive — With this technique, high voltage is also used to rapidly build the current in a phase winding. When the current reaches a predetermined level, or after a predetermined time, the high voltage is switched off and a second lower voltage is automatically used to maintain the phase winding current at its desired value. When a new phase is switched on, the high voltage is again applied; and when the current is up to its desired level the high voltage is switched off (see Figure 3, page 11).

At higher speeds, as in the case of the chopper drive, this technique does not require switching from the high-voltage to the low-voltage power supply, and a constant high voltage is used. When the motor is at rest but still energized, current is supplied to the phase winding by the low-voltage power supply.

The advantage of this type translator results from its higher efficiency and non-dissipative nature. Additionally, there is no audio noise from the motor and translator when the motor is energized and at rest. The disadvantages of this technique are the increased circuit complexity and the need for a second power supply.

Variable voltage drive — With this technique the input voltage is varied depending on the speed requirements. Typically, a switching regulator increases the voltage available to the motor as the motor speed increases. A filter is required after the switching regulator so that the motor voltage is smooth and free from harmonic disturbances (see Figure 4, page 11). All radio frequency interference is absorbed at the source where switching is taking place. The result is a programmed voltage source that is available to the motor depending upon speed of operation.

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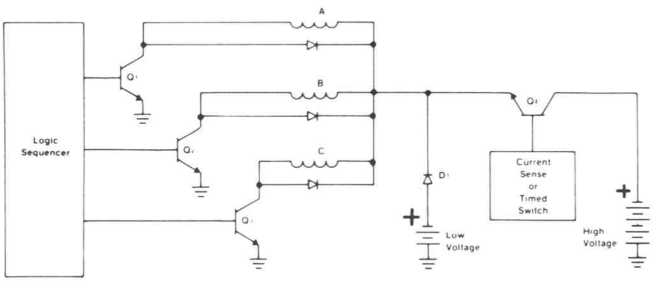

Figure 3 — Simplified dual voltage driver.

The advantage of this type of translator is its higher efficiency and non-dissipative nature. Also, better performance at high motor speeds can be obtained. The disadvantages are the increased complexity of the circuit and the need for an added power filter consisting of an inductor and capacitor. Also, speed of voltage response is limited, thus limiting the motor's transient response for short acceleration moves.

The decay of the phase current also requires care and understanding to maximize the performance of a translator. When a phase winding is switched off, the magnetic energy in the coils must be non-destructively removed. This part of the translator is called the suppression circuit, which can consist of circulating diodes (D_S) with resistors (R_S), or feedback diodes, depending on the translator scheme involved and the type of motor.

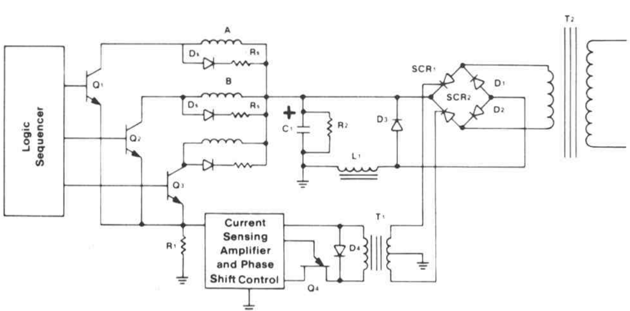

Figure 4 — Variable voltage step motor control. The SCRs control the voltage to provide constant current in the motor coils at all times. R_1 is the current sensing resistor.

Logic and control system

The control system consists of electronic circuitry that generates the precise number and sequence of command pulses for the translator. This usually involves digital logic circuitry with supervisory input from a computer or other data source. Command pulses can be generated with either open-loop or closed-loop control.

Open loop control — With open-loop control, motor pulses are generated independent of feedback indication of motor position. It is assumed that the motor will maintain synchronism with the input pulses. A failure to do so constitutes a system malfunction.

Because torque of a step motor depends on rotor position, every instant can be critical in switching the phase windings. The input sequence, therefore, plays a dominant role in successful operation of the motor. If input pulses are not programmed properly for a specific task, the motor can fail to maintain synchronism. If the pulses are properly spaced, the motor can perform to its maximum capacity.

Pulses can be generated by analog oscillators (such as those based on the 555 timer circuit), or by microprocessors, minicomputers or other digital pulse generating devices.

If open-loop control can provide the required performance, the result is usually a simple and cost-effective system.

Closed-loop control — With closed-loop control, a feedback device is used to indicate motor position, thus enabling the control system to generate pulses for accelerating or decelerating the motor. Feedback is needed only once per step and usually consists of an optical encoder, which is a slotted disc with some optoelectronic sensing circuitry.

Acceleration and deceleration performance can usually be improved over open-loop control. This is because additional information is available to provide a more optimum switching sequence.

The advantage of using closed-loop control is the extra performance obtained from a specific motor and translator. The main disadvantage is the cost of an encoder and associated electronics. Also, closed-loop control is more complex than open-loop control, and there may be less overall system reliability. There are, however, no loop stability problems associated with closed-loop control. And there are no bandwidth compromises because feedback is strictly in a logic sense, and the digital circuitry driving the motor can still operate at its maximum designed frequency.

continued on page 12

In addition to generating the proper pulse sequence, the step motor control system must continually monitor the distance requirements and provide the appropriate number of pulses to the motor. Sometimes a supervisory control such as a computer provides basic information about distance and speed, and a second level dedicated hardware control, often called an indexer, is used to generate the individual pulses.

For more information about step motors, please contact **John Thomas, ext. BDR-2466**.

Sessions available on New Product Introduction

Two information sessions about the New Product Introduction (NPI) Phase System, the framework for all new product development at Tek, are now available through the Corporate NPI Group.

"Introduction to NPI" is a one-hour overhead presentation of basic facts and definitions related to the NPI Phase System. The presentation covers the system's purposes, the five phases, their milestones and criteria. It also illustrates the activities that occur in the business units and various support groups during each of the five phases of development.

Included in this presentation is information about the Software/Firmware Phase System which, like the NPI Phase System, is administered by the Corporate NPI Group.

In "Critical Path Timeline", leadtimes and time relationships among critical path activities in a new product's development schedule are explained. The presentation consists of a lecture illustrated by a chalkboard timeline. This session lasts from one to two hours, depending on the group and the number of questions.

We recommend that persons attending the "Critical Path Timeline" session have a working familiarity with the NPI Phase System, which can be gained by attending the introductory session.

These presentations may be requested by groups of ten or more persons by calling **Nancy K. Anderson, ext. BDR-1735**.

Don't be con"fused" by these fuses

A new style of subminiature fuses will begin appearing in assembly areas in December 1981. These are totally encapsulated, epoxy-coated parts which could easily be mistaken for a resistor, capacitor or diode (see illustration, below).

(actual size)

Called Pico II fuses, the parts feature low resistance values, high-speed action, insulated terminations and protection against environmental extremes. Also, they are IEC color coded for easy identification (color code chart follows). The first three bands indicate current rating, and the fourth (wider) band designates the time/current characteristics for the fuse (red = normal blow).

Rated Current (mA)	First Band	Second Band	Third Band	Fourth Band
62	Blue	Red	Black	Red
100	Brown	Black	Brown	Red
125	Brown	Red	Brown	Red
250	Red	Green	Brown	Red
375	Orange	Violet	Brown	Red
500	Green	Black	Brown	Red
750	Violet	Green	Brown	Red
1000	Brown	Black	Red	Red
1500	Brown	Green	Red	Red
2000	Red	Black	Red	Red
2500	Red	Green	Red	Red
3000	Orange	Black	Red	Red
3500	Orange	Green	Red	Red
4000	Yellow	Black	Red	Red
5000	Green	Black	Red	Red
7000	Violet	Black	Red	Red
10000	Brown	Black	Orange	Red
12000	Brown	Red	Orange	Red
15000	Brown	Green	Orange	Red

The Pico II fuses are available in radial and axial lead configurations, and may also be machine-inserted.

Component Engineering wants all assembly areas to be aware that these fuses are coming and that they may be confused with other parts. If you have any questions, or for more information, please contact **Dennis Johnson, ext. BDR-2471**.

TECHNICAL STANDARDS

New documents (copies may be ordered through Technical Standards)

ASTM D 295	Varnished Cotton Fabrics used for Electrical **Insulation**.
ASTM D 2526	Ozone-Resisting Silicone Rubber **Insulation for Wire & Cable**.
ASTM D 2902-81	Fluoropolymer Resin Heat-Shrinkable **Tubing**.
ASTM D 3949-80	Coated Glass Fabrics used for Electrical **Insulation**.
MIL-F-7179E	**Finishes and Coatings**: Protection of Aerospace Weapons Systems, Structures and Parts.
NASA-CR-1128	Practical Reliability, **Volume III — Testing**. Basic approaches to testing, emphasizing practical considerations and the applications to reliability.
ASTM D 3580-80	**Vibration** (Vertical Sinusoidal Motion) Test of Products.
UL 67	**Panelboards**.
DOD Instruction	Agreements with Australia and Canada for **Qualification of Products** of Nonresident Manufacturers.
DOD Standardization Program Analysis, Federal Stock Group 60	**Fiber Optics** Materials, Components, Assemblies and Accessories.
Rockwell International	Toward a New Standard for **Calibration Systems** and Measurements. 27 Sept 1979 by Rolf B.F. Schumacher.
Technical Digest	Third International Conference on Integrated **Optics** and Optical Fiber Communication, 1981.
IEEE Optical Fiber Technology II	Provides background on the latest progress with **optical fibers**.

Notice

A number of Tektronix Standards are being reviewed for possible update. If you know of any changes that should be made to a standard, please notify Technical Standards on ext. BDR-1800.

Technical Standards will order printed documents or send microfiche copies of industrial and military standards to all requestors. Orders can be placed by telephone (BDR-1800), or memo. Please include your name, delivery station, telephone extension and responsibility/cost center number. Send requests to 58-306.

A new system at Technical Standards

In order to ensure having current technical reference documents for Tek people, Technical Standards has subscribed to a Visual Search Microfiche System. Most of the documents we have been purchasing as printed material will now be sent to us on microfiche.

This means less expensive and faster response to documentation needs. When you ask Technical Standards for a document, we will either/or:

1. Check our fiche index to see if we have it.
2. Send you a duplicate microfiche so you may read the document in your area.
3. Ask you to use our reader-printer to locate the information you need.
4. Make a copy for you.

If we do not have the document on fiche, we will order a printed copy to your account number as before.

A note about cost; we intend to make the microfiche system cost-effective. It will not only provide current documents without delay, but will save your department money in costs of purchasing printed copies from outside publishers. Although it will be necessary for us to transfer some costs, overall savings to Tektronix should be significant.

For information about these standards contact Bonnie Kooken, ext. BDR-1800.

Status update
SSI/MSI digital IC reliability project

Component News 288 (May 5, 1981) described the SSI/MSI digital IC reliability project. This project is now well under way, with many of the first 100 part numbers upgraded to the higher quality and reliability versions. Following this article is the change list for the second 100 part types.

The status of the quality and reliability verification of these parts, as of Sept. 18, 1981 is:

1. Incoming Inspection has the test equipment and procedures in place to verify the **electrical** performance on the first 200 parts to the specified quality level: LTPD = 3 for 70°C. DC parametric and LTPD = 1 for functional at 70°C. Incoming lots for the first 200 part types of dash number versions representing the higher quality and reliability level parts are being verified to this level, effective immediately. These quality levels should result in a maximum defect level of 0.1% for functionality.

2. Component Test Engineering has negotiated the purchase of equipment for reliability verification (high temperature life test oven and temperature cycling chamber). This equipment should be in place and operational by Period 210.

Division NPI coordinators and mod processors have been notified of the effective dates of changeover from the base part number to the dash number calling out higher quality and reliablity. Questions on effective dates should be addressed to them.

Ron Schwartz
Component Reliability Eng.
58-061, ext. BDR-1605

From	Status	To	Status
156-0073-00	CR	156-0073-02	CR
156-0073-01	CR	156-0073-02	
156-0165-00	CR	156-0165-02	CR
156-0165-01	CR		
156-0284-00	CR	156-0284-03	CR
156-0284-01	CR		
156-0284-02	DE		
156-0304-00	CR	156-0304-02	CR
156-0304-01	CR	156-0304-02	
156-0311-00	CR	156-0311-02	PP
156-0324-00	CR	156-0324-03	CR
156-0324-01	CR		
156-0330-00	CR	156-0330-02	CR
156-0330-01	CR		
156-0347-00	CR	156-0347-02	CR
156-0347-01			
156-0351-00	OT	156-0351-01	PP
156-0366-00	CR	156-0366-02	CR
156-0366-01	CR		

From	Status	To	Status
156-0374-00	CR	156-0374-02	CR
156-0374-01	CR		
156-0390-00	CR	156-0390-02	CR
156-0390-01	CR		
156-0396-00	CR	156-0396-02	CR
156-0396-01	CR		
156-0405-00	CR	156-0405-03	CR
156-0405-01	CR		
156-0405-02	CR		
156-0419-00	CR	156-0419-02	CR
156-0419-01	CR		
156-0451-00	CR	156-0451-02	CR
156-0452-00	CR	156-0452-02	CR
156-0452-01	CR		
156-0455-00	CR	156-0455-02	CR
156-0455-01			
156-0465-00	CR	156-0465-02	CR
156-0465-01	CR		

continued on page 15

From	Status	To	Status
156-0467-00	CR	156-0467-02	CR
156-0467-01	CR		
156-0470-00	CR	156-0470-02	CR
156-0470-01	CR		
156-0471-00	CR	156-0471-02	CR
156-0471-01	CR		
156-0472-00	CR	156-0472-03	CR
156-0472-01	CR		
156-0473-00	CR	156-0473-02	CR
156-0473-01	CR		
156-0478-00	CR	156-0478-02	CR
156-0478-01	CR		
156-0494-00	CR	156-0494-02	CR
156-0494-01	CR		
156-0497-00	CS	156-0497-02	CR
156-0497-01	CS		
156-0503-00	CR	156-0503-02	CR
156-0503-01	CR		
156-0508-00	CR	156-0508-02	PP
156-0508-01	CR		
156-0522-00	CR	156-0522-02	CR
156-0522-01	CR		
156-0523-00	CR	156-0523-01	CR
156-0524-00	CR	156-0524-02	CR
156-0524-01	CR		
156-0525-00	CR	156-0525-03	CR
156-0525-01	CR		
156-0531-00	CR	156-0531-02	CR
156-0531-01	CR		
156-0535-00	CR	156-0535-02	CR
156-0535-01	CR		
156-0536-00	CR	156-0536-02	PP
156-0536-01	CR		
156-0541-00	CR	156-0541-02	CR
156-0541-01	CR		
156-0545-00	CR	156-0545-01	CR
156-0567-00	CR	156-0567-02	CR
156-0567-01	CR		
156-0569-00	CR	156-0569-01	DL
156-0575-00	CR	156-0575-03	CR
156-0575-01	CR		

From	Status	To	Status
156-0576-00	CR	156-0576-02	CR
156-0576-01	CR		
156-0578-00	CR	156-0578-02	CR
156-0578-01	CR		
156-0579-00	CR	156-0579-02	CR
156-0579-01	CR		
156-0580-00	CS	156-0580-02	CS
156-0580-01	NP		
156-0582-00	CR	156-0582-03	CR
156-0582-01	CR		
156-0583-00	CR	156-0583-02	CR
156-0583-01	DL		
156-0583-03	CR		
156-0617-00	CR	156-0617-02	CR
156-0617-01	CR		
156-0629-00	CR	156-0629-01	CR
156-0645-00	CR	156-0645-02	CR
156-0645-01	CR		
156-0653-00	CR	156-0653-02	CR
156-0653-01	CR		
156-0681-00	CR	156-0681-02	CS
156-0681-01	CR		
156-0693-00	CR	156-0693-02	CR
156-0693-01	CR		
156-0696-00	CR	156-0696-02	CR
156-0696-01	CR		
156-0703-00	CR	156-0703-02	CR
156-0703-01	CR		
156-0720-00	CR	156-0720-02	CR
156-0720-01	CR		
156-0722-00	CR	156-0722-02	PP
156-0722-01	CR		
156-0728-00	CR	156-0728-02	CR
156-0728-01	CR		
156-0731-00	CR	156-0731-02	CR
156-0731-01	CR		
156-0736-00	CR	156-0736-02	CR
156-0736-01	CR		
156-0738-00	CR	156-0738-04	CR
156-0738-01	CR		
156-0738-02	CR		

continued on page 16

From	Status	To	Status
156-0745-00	CR	156-0745-01	CR
156-0752-00	CR	156-0752-01	CR
156-0756-00	CR	156-0756-01	CR
156-0765-00	CR	156-0765-04	CR
156-0765-01	CR		
156-0786-00	CR	156-0786-02	CR
156-0786-01	CR		
156-0788-00	CR	156-0788-01	CR
156-0795-00	CR	156-0795-01	CR
156-0799-00	CR	156-0799-01	CR
156-0800-00	CR	156-0800-01	CR
156-0801-00	CR	156-0801-01	CR
156-0804-00	CR	156-0804-02	CR
156-0804-01	CR		
156-0861-00	CR	156-0861-01	PP
156-0874-00	CR	156-0874-02	CR
156-0874-01	CR		
156-0878-00	CR	156-0878-01	CR
156-0879-00	CR	156-0879-01	CR
156-0888-00	CR	156-0888-02	CR
156-0888-01	CR		
156-0896-00	CR	156-0896-01	CR
156-0898-00	CR	156-0898-01	PP
156-0913-00	CR	156-0913-02	CR
156-0913-01	CR		
156-0915-00	CR	156-0915-02	CR
156-0915-01	CR		
156-0948-00	CR	156-0948-02	CR
156-0948-01	CR		
156-0951-00	CR	156-0951-02	CR
156-0951-01	CR		
156-0953-00	CR	156-0953-02	CR
156-0953-01	CR		
156-0957-00	CR	156-0957-01	CR
156-0966-00	CR	156-0966-01	CR
156-0970-00	CR	156-0970-03	CR

From	Status	To	Status
156-0975-00	CR	156-0975-02	CR
156-0975-01	CR		
156-0985-00	CR	156-0985-01	CR
156-0989-00	CR	156-0989-02	CR
156-0989-01	CR		
156-0990-00	CR	156-0990-01	CR
156-1026-00	CR	156-1026-02	CR
156-1026-01	CR		
156-1045-00	CR	156-1045-01	CR
156-1046-00	CR	156-1046-02	CR
156-1046-01	CR		
156-1061-00	CR	156-1061-02	CR
156-1061-01	CR		
156-1064-00	CR	156-1064-02	CR
156-1064-01	CR		
156-1065-00	CR	156-1065-01	CR
156-1080-00	CR	156-1080-01	CR
156-1111-00	CR	156-1111-02	CR
156-1111-01	CR		
156-1172-00	CR	156-1172-01	CR
156-1176-00	PP	156-1176-01	CR
156-1177-00	PP	156-1177-01	CR
156-1179-00	CR	156-1179-01	CR
156-1198-00	CR	156-1198-01	CR
156-1216-00	DL	156-1216-01	CR
156-1229-00	CM	156-1229-01	CR
156-1258-00	PP	156-1258-01	CR
156-1273-00	CR	156-1273-01	CR
156-1275-00	DL	156-1275-02	PP
156-1275-01	DL		
156-1340-00	CR	156-1340-01	CR

Don't push over that tab

There have been reports recently of TO-202-packaged power transistors that have either failed catastrophically or have very high $V_{CE(SAT)}$ measurements.

Instead of a vendor-caused flaw, the failure mechanism was user-related: during installation in the ECB, the device's tab was being bent 90° by hand without any mechanical strain relief. This operation subjects the die and wire bonds to enormous stress, causing die cracking and bond wire breakage. This situation is a recurring caution notice in all of our vendors' literature about device handling and mounting.

There are two methods to safely bend tabs:

1. Use a fixture similar to a sheet-metal brake (see Figure 1) to clamp between the device and the bend. Then have the fixture do the actual tab forming. This is the recommended practice, as it lends itself to repeatability in the bending action.

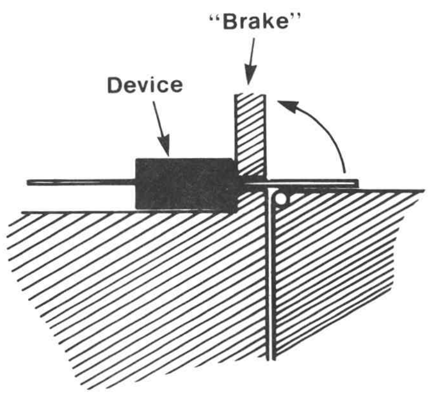

Figure 1

2. For small-scale operations, use flat-clamp longnose pliers to provide mechanical strain relief at the device body; then the tab can be hand bent (see Figure 2).

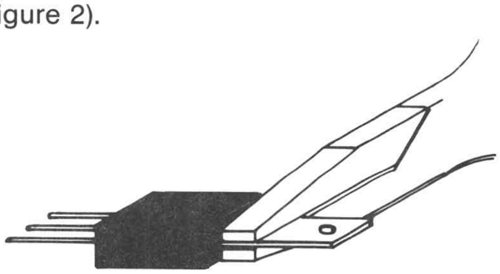

Figure 2

These same precautions are applicable to lead-forming for all plastic transistor and voltage regulator packages. More information about lead forming is in the Tek Semiconductor Parts Catalog, Section 9.

If you have any questions about this procedure, please contact **Jim Williamson, ext. BDR-2552**.

component news

Component News is published by Technical Communications (58-122)

Jacquie Workman, editor
Eileen Yee, illustrator
Loretta Clark, layout/paste-up

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78-557
J BRADFORD BENSON
COMPONENT NEWS