component news

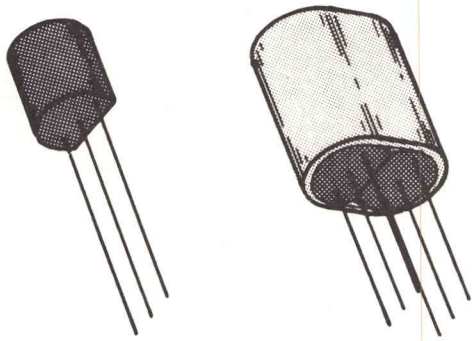
July 21, 1980 COMPANY CONFIDENTIAL Issue 282

New JFETs have low noise

A new line of super low noise junction FETs has recently been introduced by Toshiba. These parts feature other characteristics in addition to low noise that make them very unique among JFETs.

Designed and built for use in high-end component stereo amplifiers, they can also improve the performance of similar circuits.

They are available as singles and duals (actually a matched pair fastened together) and most uniquely as complementary N- and P-channel parts, both singles and duals. The N- to P-type matching is excellent for all important parameters except capacitance (see Figure 1, page 2).



The Toshiba dual FETs are actually two slightly taller TO-92 plastic transistors pressed into an aluminum can. The middle lead on each side is the gate. The other two leads, the source and drain, are electrically symmetrical, so the part can be rotated 180° with no effect.

The pricing is also excellent. The prices are much lower than other low-noise JFETs that actually have more noise. Also, there is no domestic source for well matched complementary JFETs of any kind, much less low noise devices.

Their characteristics are those of a large geometry FET (151-1021-XX, for example) that has been processed to produce a low value of pinch-off (V_P) and I_{DSS}. The results are somewhat misleading; the I_{DSS} range (5-30 mA) is that of much smaller conventional FETs. However, the g_m and C_{iss} reveal the devices' true size — big!

The P-channel parts are even bigger. Because the mobility of holes is about 40% less than electrons, a P-channel FET must have 40% larger area to get an equal g_m of the N-channel part.

Also, for the same size part, a P-channel FET will have more gate capacitance. The combined effect is that the P-channel capacitance is two and a half times that of the N-channel. For true complementary JFETs this will always be true.

Another peculiar feature of these parts is that the temperature coefficient (TC) of the drain current is positive not the usual negative found in other JFETs. This is a result of the V_P being small — close to the 0.6 V barrier potential of silicon. (According to one authority contacted, such low V_P's are necessary for the lowest possible noise).

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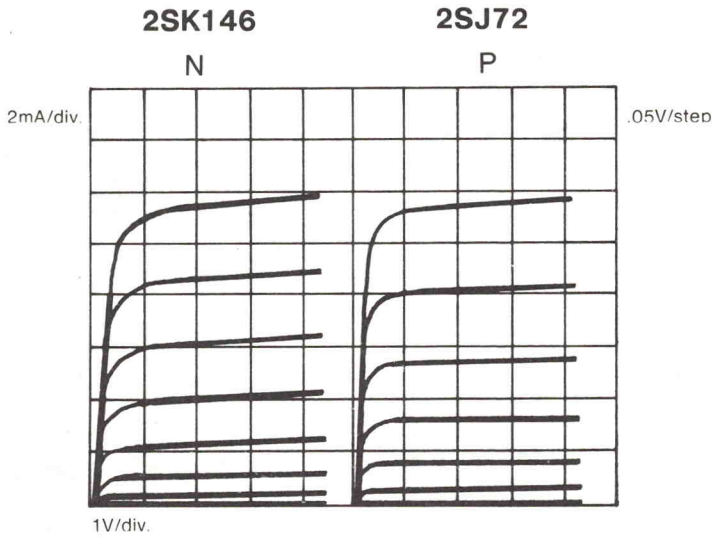
Also in this issue

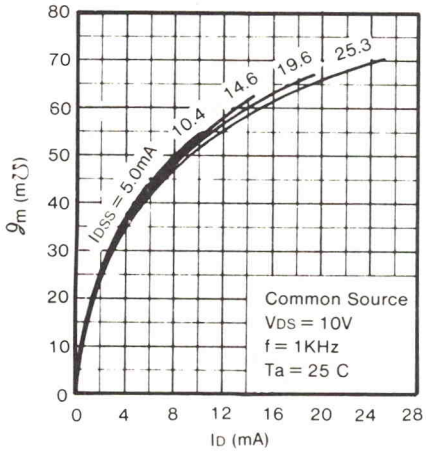
Figure 1

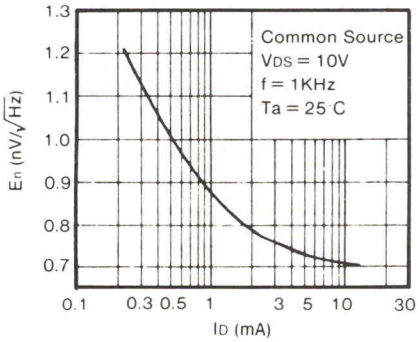


Randomly selected N and P pairs are fairly well matched. One characteristic difference, visible in this curve tracer display, is that the P-channel parts have slightly higher output resistance than the N-channel parts. Incidentally, this is also the reverse of conventional FET characteristics.

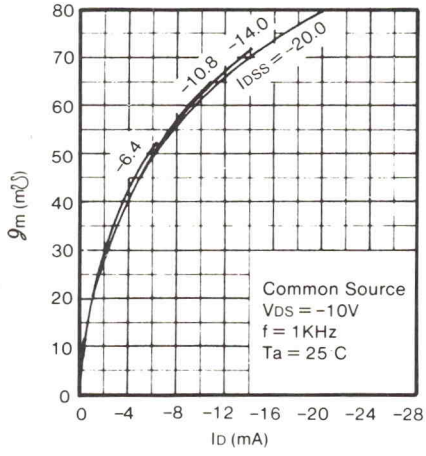
The graphs which follow show all of the important parameters with the N-channels on the left and the P-channels on the right.

2SK146





2SJ72



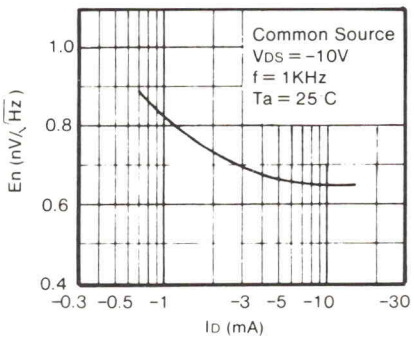


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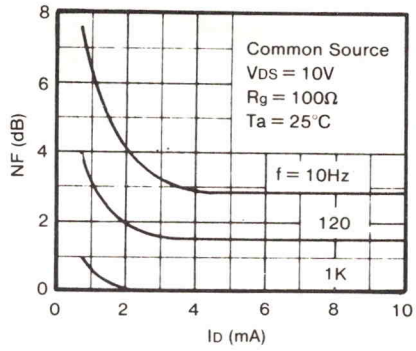
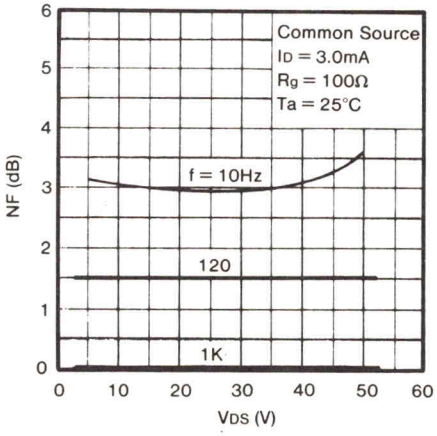
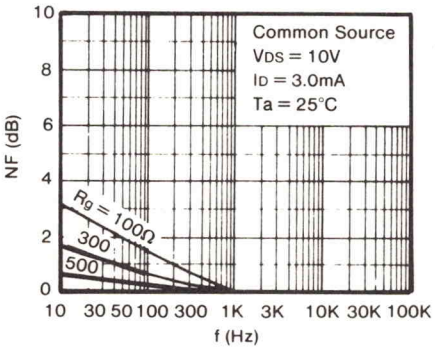
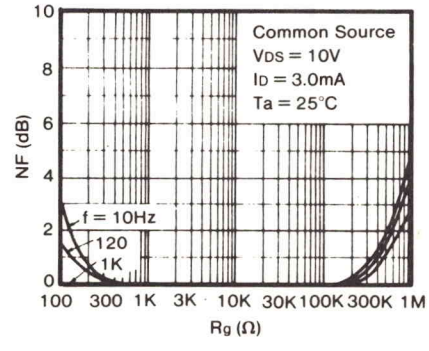
Figure 1 (continued)

2SK146

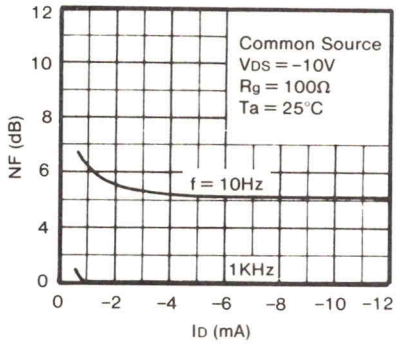


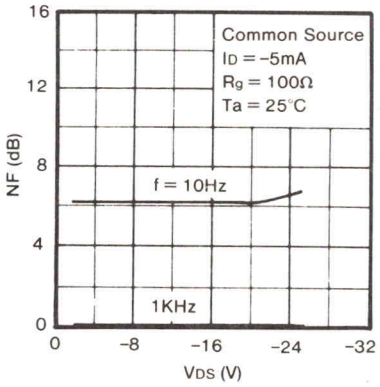


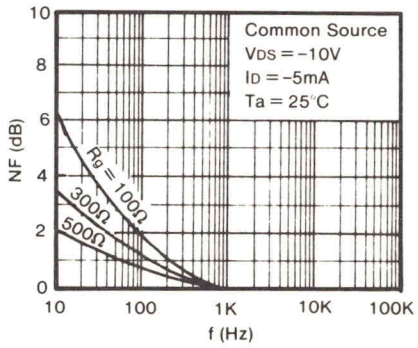


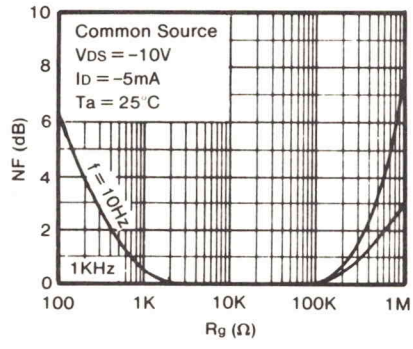


2SJ72









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Thermal instability in some circuits can be eliminated by using the dual version of the parts. Also, with both N- and P-channel dual parts available, a very elegant dual differential circuit is possible (see Figure 2). Of course, here we have four parts contributing to the noise but the dynamic range and linearity is excellent and the noise will be as good as any such circuit will have.

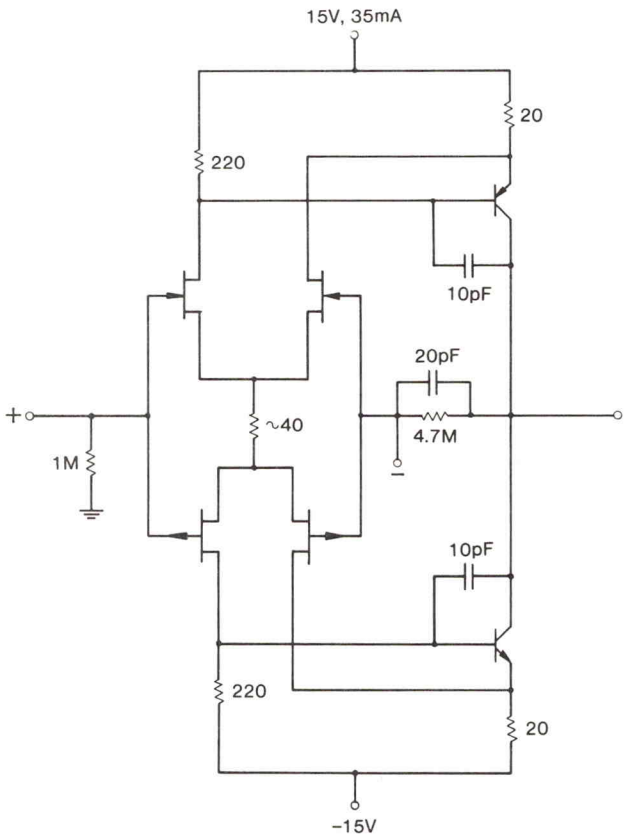


Figure 2 — This circuit belongs to consultant John Curl who designed it for the esoteric audio equipment of producer Mark Levinson. It features low noise, good linearity and fast slew rate — qualities often sought after in other applications.

Pricing

	Quantity		
	100-999	1K-9999	>10K
N-Channel: 2SK146 (dual)	$1.40	$1.28	$1.23
2SK147 (single)	0.64	0.58	0.56
P-Channel: 2SJ72 (dual)	$2.19	$2.00	$1.92
2SJ73 (single)	0.97	0.88	0.85

Characteristics

	N-Channel	P-Channel	Units
BV_{DGS}	40	25	V
I_{DSS}	5-30	5-30	mA
V_P	0.3-1.2	0.3-2.0	V
g_m	30 min.-40 typ.	30 min.-40 typ.	m℧
C_{iss}	75 typ.	185 typ.	pF
C_{rss}	15 typ.	55 typ.	pF
Offset (duals)	20	20	mV

For more information

If you have any questions about these parts please contact me at 78-557, ext. DR-2539.

Jerry Willard
Analog Component Engineering

New personnel in Digital CE

Two new engineers have joined the Digital Component Engineering group.

John Higley will be the engineer in charge of the 6801 microprocessor. He will also back up Bruce Brown with the technical assistance for the low-power Schottky family of TTL devices. Dale Coleman will be John's advisor in technical matters. John will graduate this fall from Portland State University, with a Bachelors degree in EE. He has worked in Component Engineering previously as a summer hire.

Ken Smith will be the engineer in charge of the 8035 microprocessor. He will also back up Bruce with assistance for the standard line of TTL devices. Wilton Hart will be Ken's advisor. Ken is a recent graduate, with a Bachelors degree from Oregon Institute of Technology. He is moving here from Klamath Falls.

Phil Brothers, manager
Digital Component Engineering

Component reliability reports available

The Component Reliability Engineering group at Walker Road conducts numerous evaluations to determine cost-effective component screening and reliability assurance test procedures. To this end, the group publishes reliability reports on the various component categories under evaluation. Following are abstracts of three recent evaluation reports, plus information on how to receive the complete report if you desire it.

Optoelectronic device reliability

Three extensive studies on optoelectronic devices have been completed. They concern: DIP optical isolator reliability, discrete LED reliability, and 7-segment LED display reliability.

Field failures were generally experienced as intermittents or opens. Failure analysis indicated thermo-mechanical problems, especially with certain vendors' parts. Some failures were lot related.

In the tests, several hundred parts were subjected to extended temperature cycling and then electrically tested at high temperature to detect intermittents. Results are compared by vendor and are available in the complete report. The report also discusses the recommended reliability lot sample and screening tests for the various part types.

SOT (transistor for hybrid use) reliability evaluation

Six vendors' 2N3906 type SOT devices (plus several other high frequency types) have been subjected to 1300-hour accelerated high temperature life tests at 125°C, 150°C and 175°C junction. Additional samples were tested for humidity life in 85°C/85%RH.

Results are contained in a comprehensive report which describes: test conditions, results by vendor and part type, and projected failure rates at typical use conditions.

Accelerated high temperature testing

Accelerated high temperature life tests on transistors have been performed to better define the expected reliability characteristics of bipolar transistors used at high stress (over 100°C junction).

Several different part types were tested at temperatures from 175°C to 300°C to measure main population median life, freak or infant mortality populations and predict failure rates under some high-stress operating conditions.

A full report which gives graphs of failure rates vs. time for various junction temperatures is available.

For copies of any of these reports, contact Gunhild Feuchert, ext. WR-1992.

Purchasing responsibilities shift

Harriet Frank and Karen Johnson have relocated to Building 78 in Beaverton. Harriet's buying duties will include those materials and duties performed at the potentiometer desk (ext. DR-2738, delivery station 78-648).

Walt Sonksen and Cindy Elliott will assume the duties and responsibities previously executed by Harriet and Karen. The functions performed by Mildred MacDanold, Rena Nelson and Laverne Moulton will remain the same.

Allen Brown
ext. DR-2721, 78-635

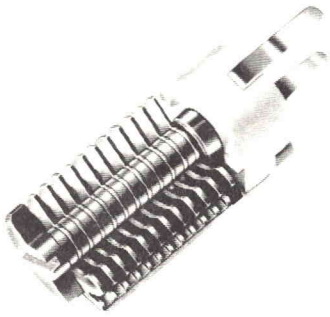
Pre-programmed PROMs & EPROMs

Memory and I/O Component Engineering is offering a new service to Tek business units. The group will pre-program PROMs and EPROMs for any instrument lines requesting it.

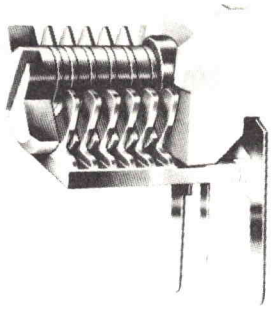
All requests will be handled on an individual basis. For more information, contact **Don Van Beek (78-557), ext. DR-2546.**

Small, economical capacitor trimmer available

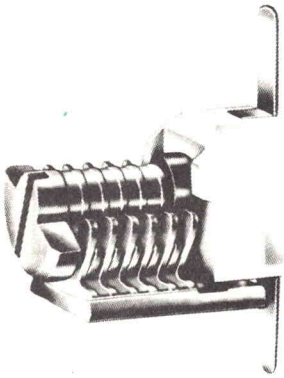
E.F. Johnson has introduced a new air variable capacitor called the "Micro T" series. It's smaller than any other vane type air trimmer — approximately 0.220" L X 0.256" W with the height ranging from 0.29" to 0.54" depending on the capacitance value. The trimmer is available in four lead configurations (see illustrations below).



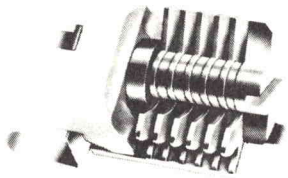
PC mount vertical tuning



PC mount horizontal tuning

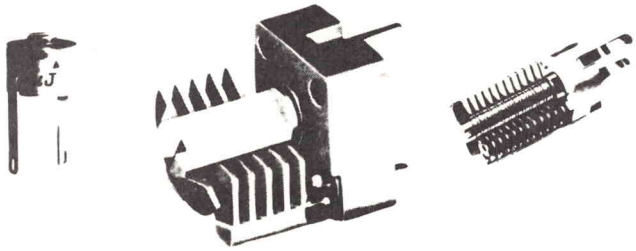


Stripline mount vertical tuning

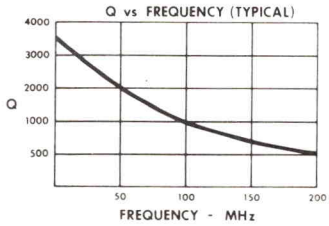


Stripline mount horizontal tuning

Because of the 0.200" lead spacing of the Micro T, there may be some applications in existing circuits now using ceramic trimmers, as well as the possibility of use in new applications. Comparing the scale drawings of a ceramic trimmer, an old style air trimmer and the Micro T (below), the space advantage of the Micro T becomes apparent. The capacitance values of all three are about the same, but the size of the old style air trimmer makes it impractical for many applications. The board space used for the ceramic trimmer is about the same as the Micro T, and the price is comparable or possibly less for the Micro T (its price has continued to drop since its introduction).



Compared to ceramic trimmers, the Micro T series has outstanding electrical characteristics — TC = 45 ±45ppm/°C, voltage = 150 (except for the 1.6 — 19.0pF part which is 100V), Q is about 1000 at 100MHz (see graph below).



The capacitance ranges available are:

Nominal Capacity (pF)	Length (in)	Voltage
1.0 — 3.0	0.29	150
1.2 — 6.5	0.37	150
1.5 — 12.7	0.54	150
1.6 — 19.0	0.50	100

Several different styles and lead configurations have already been evaluated. The torque was very constant and smooth, typically around 1 oz./in., allowing good adjustability and stability. The rotational life of the samples were all above 200 mechanical cycles (the failure mode being high torque). Voltage breakdown occurred at 500–600VDC. IR was from 5TΩ to >100TΩ.

The rotor and stator are each machined from a solid piece of brass and then silver plated. The manufacturer states that nickel plating is possible, but they would prefer to supply silver plated parts.

For trimmer applications up to 19pF, the Micro T offers all the good characteristics of an air dielectric trimmer in the size (board space) of a small ceramic trimmer — all at a competitive price. If you'd like more information, please contact **Al LaValle (78-552), ext. DR-2317.**

Evaluation of 'C' step 8291s

Intel has finally redesigned the 8291 GPIB chip to eliminate several bugs, most of which have been noted in earlier issues of **Component News.** The samples we have are the 'C' step devices which are not fully functional. 'D' step devices are expected very soon.

The most significant redesign in the chip is in the areas of Status Byte Transfer. In the new device, the 'SPASC' interrupt is set if 'rsv' is true at the moment that DAV goes true during the Status Byte Transfer. Also, the 'rsv' message within the chip is automatically cleared by the same condition which sets the 'SPASC' interrupt. Therefore, the 'rsv' bit need not be cleared prior to asserting SRQ; also, the STB transfer is the Service Response for instruments implemented with the 8291 'C' step device.

If 'rsv' is made true while the chip is in SPAS, the message takes effect upon exit from SPAS. Therefore, it is acceptable to request service again as soon as the 'SPASC' interrupt arrives regardless of the state of the interface.

Interactions between STB Transfer and Data Byte Transfer have been eliminated by a redesign of the SH function. The interactions in the older version of the device were as follows:

A. If the Data Out Register was empty prior to the 8291 being Serial Polled, on exit from Serial Poll Active State it would have a byte waiting to be sent.

B. If the Data Out Register was full prior to the 8291 being Serial Polled, the RQS Message in the STB would not be sent even if 'rsv' were true.

It was also possible in the old device to overwrite data in the Data Out Register because the chip could be taken through TIDS after a byte had been loaded into the Data Out Register but prior to its having been sourced to the bus. Moving through TIDS caused the byte to be aborted.

All of these problems have been resolved by the following changes:

A. ATN going true forces 'nba' to be cleared, aborting any pending byte out.

B. 'BO' interrupts are generated by entering TACS and by NRFD going false.

Therefore, once a 'BO' interrupt is generated, the controller can no longer take control synchronously, because the bus Acceptor has already proceeded to ACRS. If the controller allows the NRFD line to go false, and then takes control asynchronously, any byte in the 8291 Data Out Register will be aborted. Because ATN must go true in order for the 8291 to be taken from TACS to SPAS or vice versa, the two interactions listed above are eliminated.

Because the controller takes control synchronously prior to the 'BO' interrupt and the loading of the Data Out Register, there are never any valid bytes waiting to be output which may be destroyed and therefore overwritten. Also, there is no 'BO' interrupt following the last byte transmitted, which is a potential software incompatibility between the two mask sets.

Another major modification to the chip is the addition of a programmable bit in Register 'B' which, when set, will cause the AH to freeze in ACDS on receipt of <GET>,<DCL>, or <SCD>. This will allow the microprocessor time to take action in response to those commands before allowing the bus to proceed.

The circuitry which sources the 'END' message has been extensively modified. The 'Send EOI' command causes EOI to go true immediately while in TACS until the end of the data transfer; EOI goes false when DAV goes false at the end of the transfer.

The EOS compare mode for sending EOI changes the state of the END Message at the moment the Data Out Register is loaded.

When END is sent via the 'Send EOI' command, ATN going true will abort the END message. When END is sent via EOS compare, ATN

continued on page 8

going true aborts the byte itself and thus the microprocessor is guaranteed to have the chance to send a new byte with or without 'END' on re-entry of TACS. The 'EOI' line will remain aserted until the contents of the Data Out Register no longer match the EOS character.

Several State Change interrupts in the old device actually **toggled** upon the occurrence of a State Change. These bits included 'SPASC', 'REMC', and 'LLOC'. All of these bits are now **set** by State Changes and will be read true even if an even number of events occurs between successive reads of the interrupt status register.

Another change is that the INT bit read in Register-2 bit-0 is now also read in Register-6 bit-0. This is done so that polling software may access this bit without disturbing the status bits because there is a hazard if Register-1 is read at the moment one of the status bits is in the process of being set.

Assuming that the 'D' step device is fully functional, there will remain only one area of potential difficulty in this device. The device has an AH function which does not implement fully the 1978 version of the standard. If ATN is made true while DAV is true and the 8291 is in AIDS, the command recognition circuitry of the 8291 will begin to accept garbage on the GPIB data bus as valid Remote Messages. The minimum recognition time observed has been 150nS, which means that if DAV goes false within 150nS of ATN going true, the 8291 will not recognize a command or undergo a state change.

There are two cases where this situation could cause problems:

A. The controller takes control asynchronously, in which case it should send IFC and probably also <DEC> to clear the bus.

B. The controller takes control synchronously but fails to delay the assertion of ATN the required amount of time following detection of DAV false ($T_7 \geq$ 500nS).

The second case represents the greatest risks in that some older 'HP-1B'® controllers may fail to execute the T_7 delay.

In sum, the 8291 device is capable of providing a transparent GPIB interface. It is a very good choice for talker-listener instruments because of glitch-free function, and the lowest power supply current and price of any GPIB chip available.

Jim Howe
W1-3583, 63-211

Rotron discontinues fan

Rotron has discontinued their Mohawk fan series which has been part-numbered at Tek for approximately a year (P/N 119-1045-00, Rotron P/N MW2C1). This low-speed quiet version fan was offered only by Rotron and is available from no other source. It is slightly larger in outside dimension than the standard 4.68 sq. inch fan but has the same mounting holes.

A Mod has been written to replace the Mohawk fan with an in-house P/N 119-1024-00 (Rotron Muffin XL P/N MX2A3). This fan displaces approximately 15 cfm more airflow and is slightly noisier acoustically than the Mohawk. It has the same mounting holes and is slightly smaller in outside physical size than the Mohawk. The replacement fan's pressure curves exceed those of the Mohawk.

If you are considering the use of the Mohawk fan in a new application and have difficulty substituting it with the Muffin XL, please contact **Bill Stadelman in Electromechanical Component Evaluation, ext. DR-2466.**

GPIB USERS:

Are you —

- currently using any GPIB products in your work?
- planning to in the near future?

If so, please contact —

Jim Walker
Digital Product Coordination Group
50-473, ext. 5165

ComponentNewsNewComponents

This column is designed to provide timely information regarding new components, vendors, availability and price. "New Components" can also be used as an informal update to the Common Design Parts Catalogs. Samples may or may not be available in Engineering Stock.

Vendor	Number	Description	When Available	Tek P/N	Engineer to contact, ext.
		digital devices			
Fairchild, Signetics	100101	Triple 5-input OR/NOR gates, ECL, 24-pin DIP	now	156-1520-00	D. Coleman, 2573
	100102	Quint 2-output OR/NOR gates, ECL, 24-pin DIP	now	156-1519-00	
	100107	Quint exclusive OR/NOR gates, ECL, 24-pin DIP	now	156-1518-00	
	100107	Quint exclusive OR/NOR gates, ECL, 24-pin flat pack	now	156-1500-00	
	100112	Quad driver, ECL, 24-pin flat pack	now	156-1499-00	
	100117	Triple, 2-wide, OR/AND OR/AND invert gates, ECL, 24-pin flat pack	now	156-1498-00	
	100122	9-bit buffer gate, ECL, 24-pin DIP	now	156-1516-00	
	100122	9-bit buffer gate, ECL. 24-pin flat pack	now	156-1515-00	
	100136	4-bit binary counter/shift register, ECL, 24-pin DIP	now	156-1517-00	
	100141	8-bit shift register, ECL, 24-pin DIP	now	156-1511-00	
	100145	16 x 4-bit register file, ECL, 24-pin DIP	now	156-1514-00	
	100145	16 x 4-bit register file, ECL, 24-pin flat pack	now	156-1513-00	
	100150	Hex D latch, ECL, 24-pin flat pack	now	156-1497-00	
	100151	Hex D flip-flop, ECL, 24-pin DIP	now	156-1512-00	
	100151	Hex D flip-flop, ECL, 24-pin flat pack	now	156-1501-00	
	100155	Quad 2-input multiplexed latch, ECL, 24-pin DIP	now	156-1510-00	
	100155	Quad 2-input multiplexed latch, ECL, 24-pin flat pack	now	156-1496-00	
	100160	Dual 9-bit parity checker/generator, ECL, 24-pin DIP	now	156-1506-00	
	100166	9-bit comparator, ECL, 24-pin DIP	now	156-1505-00	
	100170	Universal demultiplexer/decoder, ECL, 24-pin flat pack	now	156-1504-00	
	100171	Triple 4-input MUX with enable, ECL, 24-pin DIP	now	156-1509-00	
	100171	Triple 4-input MUX with enable, ECL, 24-pin flat pack	now	156-1502-00	
	100180	6-bit full adder, high-speed, ECL, 24-pin DIP	now	156-1508-00	
	100180	6-bit full adder, high-speed, ECL, 24-pin flat pack	now	156-1507-00	
Zilog	Z8001	MPU, 48-pin microprocessor	now	—	W. Hart, DR-2572
Zilog	Z8002	MPU, 40-pin microprocessor	now	—	W. Hart, DR-2572
Intel	8279-5	Keyboard display interface	now	156-1535-00	W. Pfeifer, DR-2566
Synertek	6522	VIA, I/O port with timer	now	156-1539-00	W. Pfeifer, DR-2566
		optoelectronic and passive devices			
Sprague	672D	Capacitor, aluminum electrolytic, 10μF, 100V, 0.4" dia. x 0.8" single-ended, low ESR, 0.3A ripple current	now	290-0939-00	D. Anderson, DR-2545
Mallory	TCX	Capacitor, aluminum electrolytic, 50μF, 50V axial-lead, 0.53" dia. x 1.2", 0.33A ripple current	now	290-0941-00	
Sprague	6720	Capacitor, aluminum electrolytic, 100μF, 25V, 0.4" dia. x 0.8", single-ended, low ESR, 0.7A ripple current	now	290-0942-00	
Panasonic	L5	Capacitor, aluminum electrolytic, 47μF, 25V, 0.27" dia. x 0.5", single-ended, 0.14A ripple current	now	290-0943-00	
Panasonic	L5	Capacitor, aluminum electrolytic, 220μF, 10V, 0.34" dia. x 0.5", single-ended, 0.25A ripple current	now	290-0944-00	
Sprague	672D	Capacitor, aluminum electrolytic, 840μF, 10V, 0.5" x 1.4", single-ended, low ESR, 1.8A ripple current	now	290-0945-00	
Sprague	672D	Capacitor, aluminum electrolytic, 270μF, 40V, 0.5" x 1.4", single-ended, low ESR, 1.5A ripple current	now	290-0946-00	

Specs for aluminum sheets to change

Our specification for the surface finish of aluminum sheets has been difficult for our manufacturers to meet. Because this has been an ongoing problem for a number of years, it seems that we have no choice but to ease our specs a little bit if we want continuous supply of this material.

New surface quality requirements for aluminum sheets are:

1. A call-out for one good "preferred" side only, and the other side of a sheet in "mill" finish. All of our suppliers can guarantee only one good side because of manufacturing constraints at the mills.

2. Both sides of the sheet shall be commercially flat, smooth and free from buckles. There shall be no evidence of pick-up of foreign matter, gouges, cracks, seams, dents, oxide streaking, corrosion or stains.

3. Preferred side: Roller marks, scratches, pits and other such minor defects shall not exceed 0.0005" deep.

4. Mill-finish side: Roller marks, scratches, pits and other such minor defects shall not exceed 0.001" deep.

5. Edge burrs or protrusions parallel to the edge, and perpendicular to the sheet side, shall not exceed 0.0015" high.

Sheet metals affected by these changes to the specification are aluminum alloys 5052-H34, 5052-H32, 5005-H34 and other sandable sheets and plates with a thickness greater than 0.040".

It is therefore recommended that design engineers intending to use any of these materials (where cosmetic appearance is important) arrange to have only the good side of the material showing. Also, if the part must be bent where both sides of the material are exposed, be sure to make provisions for the "mill side" to be camouflaged or concealed in some way. This is because we cannot be sure that after one or two sandings, this "mill side" of the part meets our quality standards.

If you have any more questions about aluminum sheets, contact **Bella Geotina (78-552), ext. DR-2315.**

CE wants failed components

The Electromechanical Component Engineering group would like to receive for analysis, purchased electromechanical components which have failed in Tektronix instruments during manufacture. The purpose is to help us better understand component failure modes and frequency of occurance. Business units sending such items to us will receive a copy of the failure analysis report. Send in-plant failures to: **Jim Deer at 78-552.**

New component engineer

Phillip Lee has joined the Electromechanical Component Engineering group, reporting to Peter Butler. Phillip's primary duties will be to provide technical support for bulk wires and cables (including RF cables), cable assemblies, bearings, gears, chassis tracks and guides, card guides and pulleys.

Phillip holds a BSME degree from Oregon State University. He can be reached at 78-559, ext. DR-2461.

Bob Aguirre, manager
Electromechanical CE

COMPONENT CHECKLIST

Tek P/N	Vendor	Description of part	Who to contact, ext.
156-1391-xx	National	Instrumentation amplifier	Willie Rempfer, DR-2308

The LF352 instrumentation amplifier is being **discontinued** by National Semiconductor. No other pin compatible source exists for the part. The closest substitute we have at this time is Analog Device's AD521J. Contact me if you have any questions about this part.

Tek P/N	Vendor	Description of part	Who to contact, ext.
290-0759-00	Sprague	290μF, 15V aluminum cap	Don Anderson, DR-2545

This part was originally set up with a 100KHz ESR specification of 0.125Ω maximum. We have been informed by our sole supplier, Sprague, that they will be shipping parts to a 0.180Ω maximum spec. It is not known if the typical part will stay below 0.125Ω.

If this ESR increase will cause you any problems, please let me know. A possible replacement for this part is the 290-0946-00, a 270μF, 40V single-ended part with 100KHz ESR less than 0.120Ω.

Product Safety announces...

The Product Safety Guidebook

The Product Safety Guidebook is a loose-leaf binder containing:

- **new product-safety and product-liability information.**
- **further clarification of product safety facts you may already know.**

Even though you consult your Product Safety Engineer, and even though you read Product Safety Notes in **Component News,** you'll still benefit from having all product-safety information in one, easy-to-use loose-leaf binder (tabs lead you to specific topics). This guidebook can save you time and effort. The guidebook has tables, charts, and graphs, and it's expandable... Product Safety will be adding to it.

The Product Safety Guidebook now contains information on such topics as:

- Enclosure requirements
- Required markings
- Internal wiring
- Emanations
- Heating
- Mechanical risks

To order a copy of the Product Safety Guidebook, fill out the order form below and mail it to Technical Standards, delivery station **41-260.**

Product Safety Guidebook Order Form

Mail to: Technical Standards, delivery station 41-260.

Please send me the new Product Safety Guidebook **(062-4785-00).**

Name _____ Delivery Station _____

Ext. _____ Payroll Code _____ Department _____

Your manager's signature _____

(We're asking for your manager's signature to help reduce duplicate orders from the same immediate area.)

TECHNICAL STANDARDS

The function of Technical Standards is to identify, describe, and document standard processes, procedures, and practices within the Tektronix complex, and to ensure these standards are consistent with established national and international standards. Technical Standards also provides a central repository for standards and specifications required at Tektronix.

Chuck Sullivan, manager (41-260)

New standards available

MIL-S-52779A	**Software Quality Assurance** Program Requirements
MIL-E-55585D(CR)	**Packaging** of Electronics Equipment and Parts
MIL-C-28859(EC)	General specification for **Connectors** Component Parts, Electrical Backpanel, Printed Wiring
NBS SP 500-48	Measurement of **Interactive Computing:** Methodology and Application
NBS SP 500-49	Modeling and Measurement Techniques for Evaluation of **Design Alternatives** in the Implementation of **Database Management Software**
NBS SP 500-50	**Computers,** Personnel Administration, and Citizen Rights
NBS SP 500-51	Recommendations for **Database Management System Standards**
NBS SP 551	Proceedings of the **1978 Electromagnetic Interference Workshop**
Tektronix Standard 062-1737-00	Communications Standards, Abbreviations and Symbols. This standard was revised 16 April 1980.
MIL-C-55302C	**Connectors,** Printed Circuit Subassembly and Accessories
MIL-C-85049	**Connector Accessories,** Electrical
MIL-C-85049/24	**Connector Accessories,** Electrical, Backshell, Nonenvironmental, 90°, Shield Termination, Category 3A
NEMA ICS 1-1978	Revision No. 3 General Standards for Industrial Control and Systems
NEMA ICS 2-1978	Revision No. 2, Industrial Control Devices, Controllers and Assemblies
NEMA ICS 1-1978	Revision No. 1, Enclosures for Industrial Controls and Systems
UL 977	Revision pages 13-14 for Standard for Fused Power-Circuit Devices. Pages for the second edition of UL 977.
MIL-I-5099B	**Indicator,** Cabin Air Pressure, 1⅞ Inch Dial, Type MA-1
MIL-F-14256D	**Flux,** Solder, Liquid (Rosin Base)
MIL-C-85049/6	Connector Accessories, Electrical, Backshell, Cable Sealing, 45°, Shield Termination, Category 1A
MIL-S-13484C	Switches, Sensitive: 30 Volts Direct Current Maximum, Waterproof

Publications available

The following publications are available from the American National Standards Institute (ANSI), or may be purchased through Technical Standards.

ISO STANDARDS HANDBOOKS	
Handbook No. 1 - 1977, Information Transfer	$ 46.20
Handbook No. 2 - 1979, Units of Measurement	20.00
Handbook No. 3 - 1979, Statistical Methods	25.20
Handbook No. 4 - 1979, Acoustics, Vibration and Shock	46.20
SPECIAL PRICE FOR ALL FOUR HANDBOOKS, per set	$125.00

Standards contact system

Technical Standards is establishing a Standards contact system through the business units. Under this system a number of people will have the responsibility for seeing that new standards and major revisions are reviewed and approved. While this contact system is being formed it is possible some people will receive duplicate draft standards for comment. We would appreciate being informed when this happens. Contact Technical Standards, 41-260, ext. TC-241.

Component Engineers

Call the appropriate engineer listed below for information on purchased components. Delivery stations are: Analog CE — 78-557, Digital CE — 78-573, Electromechanical CE — 78-552, Memory & I/O CE — 78-557, Optoelectronic & Passive CE — 78-552. Extensions are all Beav. DanRay.

ATTENUATORS ..... Byron Witt 2479
BATTERIES ..... Byron Witt 2479
BULBS ..... Halsey Royden 2314
CABLE ASSEMBLIES ..... Phillip Lee 2461
CAPACITORS
- **ceramic** ..... Ray Powell 2550
- **electrolytic, film** ..... Don Anderson 2545
- **variable, mica** ..... Dave Hayes 2317

COILS ..... Harry Ford 2310
CONNECTORS ..... Peter Butler 2474
CORES, ferrite ..... Byron Witt 2479
CRYSTALS & SAW ..... Byron Witt 2479
DELAY LINES ..... Byron Witt 2479
DIODES
- **visible LEDs** ..... Alan LaValle 2317
- **IR emitter, laser diode** ..... Louis Mahn 2549
- **all others** ..... Gary Sargeant 2540

DISPLAYS ..... Alan LaValle 2317
ELECTROMECHANICAL PRINTERS ..... Jim Deer 2484
FANS ..... Bill Stadelman 2466
FETs ..... Jerry Willard 2539
FIBER OPTICS, cables, emitters, decoders ... Louis Mahn 2549
FILTERS
- **air** ..... Bill Stadelman 2466
- **crystal** ..... Byron Witt 2479
- **light** ..... Louis Mahn 2549
- **line** ..... Dennis Johnson 2473/Herb Zajac 7887

FUSES, FUSEHOLDERS ..... Dennis Johnson 2473
GASKETS ..... Bella Geotina 2315
GENERATORS ..... Bill Stadelman 2466
GPIB ..... Bill Pfeifer 2566
HARDWARE, miscellaneous ..... Eleanor Olson 2498
HEAT SINKS ..... Jim Williamson 2552
INDUCTORS ..... Harry Ford 2310
INTEGRATED CIRCUITS ..... see microcircuits
JOYSTICKS ..... Jim Deer 2484
KEYBOARDS ..... Halsey Royden 2314
KNOBS ..... Eleanor Olson 2498
LAMPS, LAMP SOCKETS ..... Halsey Royden 2314
LIGHT-EMITTING DIODES ..... Alan LaValle 2317
MAGNETIC TAPE HEADS ..... Bill Stadelman 2466
METERS
- **digital panels** ..... Chris Martinez 2312
- **general** ..... Dennis Johnson 2473

MICROCIRCUITS
- **A/D converters** ..... Chris Martinez 2312
- **analog switches** ..... Jerry Willard 2539
- **bubble memory devices** ..... Brad Benson 2557
- **CCD/analog** ..... Willie Rempfer 2308
- **CMOS devices** ..... Wilton Hart 2572
- **communications circuits, analog** ..... Matt Porter 2311
- **comparators** ..... Willie Rempfer 2308
- **data communications, digital** ..... Bill Pfeifer 2566
- **D/A converters** ..... Don Gladden 2551
- **EAPROMs** ..... Don Van Beek 2546
- **EPROMS, PROMs** ..... Don Van Beek 2546
- **ECL devices** ..... Dale Coleman 2573
- **FPLAs, PALs** ..... Dale Coleman 2573

MICROCIRCUITS, continued
- **high speed logic** ..... Dale Coleman 2573
- **linear devices** ..... Don Gladden 2551
- **low-power Schottky TTL** ..... Bill Pfeifer 2566
- **MOS (general)** ..... Bill Pfeifer 2566
- **operational amplifiers** ..... Willie Rempfer 2308
- **regulators, linear** ..... Chris Martinez 2312
- **regulators, switching** ..... Jim Williamson 2552
- **RAMs, dynamic** ..... Bob Goetz 2543
- **RAMs, static** ..... Pete Reitmajer 2555
- **ROMs** ..... Don Van Beek 2546
- **Schottky TTL** ..... Dale Coleman 2573
- **TTL devices** ..... Carl Teale 2567

MICROPROCESSORS
- **bit-slice microprocessors** ..... Dale Coleman 2573
- **peripherals and interface** ..... Bill Pfeifer 2566
- **F8, 6800, 6801, 6802** ..... Carl Teale 2567
- **Z80, Z8000, 8080, 8085, 8086** ..... Wilton Hart 2572

MICROWAVE components ..... Byron Witt 2479
MONITORS ..... Harry Ford 2310
MOTORS ..... Bill Stadelman 2466
MULTIPLIERS, high-voltage ..... Gary Sargeant 2540
OEM ..... Jim Deer 2484
OSCILLATORS ..... Byron Witt 2479
PHOTOCOUPLERS ..... Louis Mahn 2549
POTENTIOMETERS ..... Gene Single 2544
POWER CORDS/receptacles/plugs .... Dennis Johnson 2473
RAW MATERIALS, metals, plastics ..... Bella Geotina 2315
READOUT DEVICES ..... Alan LaValle 2317
RELAYS, mechanical & solid state ..... Paul Johnson 2473
RESISTORS
- **fixed** ..... Ray Powell 2550
- **variable** ..... Gene Single 2544

SCRs, SCSs ..... Paul Johnson 2473
SHIELDS ..... Harry Ford 2310
SPARK GAPS ..... Paul Johnson 2473
SLEEVES, insulating ..... Bella Geotina 2315
SPEECH, input/output ..... Jim Deer 2484
SOCKETS
- **crystal** ..... Byron Witt 2479
- **all others** ..... Peter Butler 2474

SWITCHES
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- **reed** ..... Paul Johnson 2473

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TERMINATIONS ..... Byron Witt 2479
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TRANSDUCERS ..... Byron Witt 2479
TRANSFORMERS ..... Byron Witt 2479
- **power** ..... Bill Stadelman 2466

TRANSISTORS
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- **phototransistors** ..... Louis Mahn 2549
- **power** ..... Jim Williamson 2552
- **small signal, arrays** ..... Matt Porter 2311
- **triacs, unijunctions** ..... Paul Johnson 2473

TUBING, metal ..... Bella Geotina 2315
WIRE & CABLES ..... Phillip Lee 2461

Revised July 15, 1980

Buehler fan: Tek-made or purchased electronics?

Since the Buehler fan assembly was introduced in Tek products some time ago, many other instrument lines have also shown an interest in using it. If you're considering this assembly for an instrument application, it is important to use purchased electronics instead of Tek-made electronics, whenever possible.

The Buehler fan assembly is a brushless DC motor with a permanent magnet rotor which runs similar to a synchronous motor. The three phases are electronically computated, eliminating the unreliable brushes in DC motors. There are three versions of this fan assembly presently part-numbered at Tek: forward flow with electronics, forward flow without electronics and reverse flow without electronics.

Under life tests the motor fan assembly has proven to be very reliable, with some of the motors exceeding 25,000 hours of operation. But problems have arisen in the past with the electronics necessary to drive the motor. There must be a proper timing sequence between the phases to allow the fan to start at all voltage conditions (between 8 and 16 volts DC). Both the Tek and Buehler drive circuits have had problems with this timing sequence, which is established by an RC network for each phase.

Buehler has updated their electronic module with tighter tolerance capacitors that are matched for the particular phase. The Tek drive circuits have also changed to tighter tolerance capacitors and larger current drive transistors. Motor life tests are presently underway with updated versions of the Tek and Buehler electronics.

So why recommend purchased electronics over Tek-made electronics? Because it is almost impossible for an alternate source vendor to design a motor with the same winding resistance, winding inductance and permanent magnet rotor assembly in the same package size. However, using the Buehler electronics would require that only the *voltage limits* be specified for proper air flow requirements, thus making it easier for an alternate vendor to supply a complete assembly. This flexibility would allow the vendor to use a different motor and drive electronics and still meet Tek's airflow requirements.

If you have any questions about the application of this fan, please contact me on ext. DR-2466.

Bill Stadelman
Electromechanical CE

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