

BRITISH STANDARDS INSTITUTION

2 PARK STREET, LONDON W1A 2BS

Specification available from:- as shown in PD 9002, CECC 00200 and

SILICONIX LIMITED

MORRISTON, SWANSEA (UK), SA6 6NE

TELEPHONE 0792 74681

TELEX 48197

BS CECC 50 012-004

ISSUE 2 MAR 1982



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ELECTRONIC COMPONENTS OF ASSESSED QUALITY

DETAIL SPECIFICATION IN ACCORDANCE WITH

BS CECC 50 000:1980

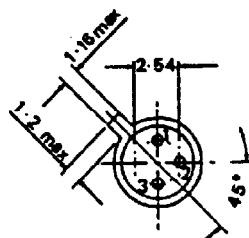
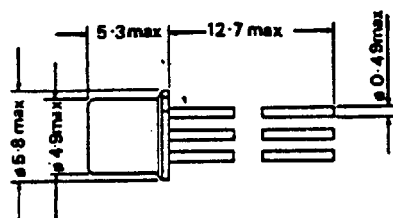
MANUFACTURER'S TYPE NUMBER

2N4391 2N4392 2N4393

Outline and dimensions

All dimensions in millimetres

Third angle projection



Terminal connections

1. Source
2. Drain
3. Gate (connected to case)

For detail dimensions see:-

IEC 191-2 B11 and C7

Marking information see clause 6

For ordering information
see clause 7

**SINGLE GATE
FIELD EFFECT TRANSISTOR**

**SILICON N-CHANNEL
JUNCTION-GATE TYPE FOR
SWITCHING AND CHOPPER
APPLICATIONS
AMBIENT RATED METAL CASE**

LEVELS OF QUALITY ASSESSMENT

E - F - L

4 LIMITING VALUES (absolute maximum system)

These apply over the operating temperature range, unless otherwise stated.

		Min.	Max.	Unit
4.1	T_{amb} Ambient operating temperature range	-65	150	$^{\circ}C$
4.2	T_{stg} Storage temperature range	-65	200	$^{\circ}C$
4.3	V_{DSS} Drain-source voltage ($T_{amb} = 25^{\circ}C$)		40	V
4.4	V_{GSR} Gate-source reverse voltage ($V_{DS} = 0$)		40	V
4.5	V_{GDO} Gate-drain reverse voltage with source open-circuited		40	V
4.6	I_{GF} Forward gate current		50	mA
4.7	I_D Drain current		200	mA
4.8.1	P_{tot} Total power dissipation ($T_{amb} = 25^{\circ}C$) See Appendix 1 for derating curve		0.3	W
	P_{tot} Total power dissipation ($T_{case} = 25^{\circ}C$)		1.8	W
	Lead temperature 1.5 mm from case for 60 s.		300	$^{\circ}C$

Refer to Qualified Products List P09002 or CECC 00 200 for availability of components approved to this detail specification.

5 CHARACTERISTICS

$T_{amb} = 25^{\circ}\text{C}$ unless otherwise stated.

† = Characteristics verified under inspection requirements.

PARAMETER AND TEST CONDITIONS		Min.	Max.	Unit
$-I_{GSS(1)}$	Maximum leakage current with drain short-circuited to source † $-V_{GS} = 20\text{ V}$ $V_{DS} = 0$ All types		100	pA
$-I_{GSS(2)}$	Maximum leakage current with drain short-circuited to source † $-V_{GS} = 20\text{ V}$ $V_{DS} = 0$ $T_{amb} = 150^{\circ}\text{C}$ All types		200	nA
$-V_{GSoff}$	Minimum and maximum gate-source cut-off voltage † $V_{DS} = 20\text{ V}$ $I_D = 1\text{ nA}$			
	2N4391	4.0	10.0	V
	2N4392	2.0	5.0	V
	2N4393	0.5	3.0	V
$I_{DSX(1)}$	Maximum drain cut-off current † $V_{DS} = 20\text{ V}$ $-V_{GS} = 12\text{ V}$ 2N4391 $V_{DS} = 20\text{ V}$ $-V_{GS} = 7\text{ V}$ 2N4392 $V_{DS} = 20\text{ V}$ $-V_{GS} = 5\text{ V}$ 2N4393		100 100 100	pA pA pA
$I_{DSX(2)}$	Maximum drain cut-off current † $V_{DS} = 20\text{ V}$ $-V_{GS} = 12\text{ V}$ 2N4391 $V_{DS} = 20\text{ V}$ $-V_{GS} = 7\text{ V}$ 2N4392 $V_{DS} = 20\text{ V}$ $-V_{GS} = 5\text{ V}$ 2N4393 $T_{amb} = 150^{\circ}\text{C}$		200 200 200	nA nA nA
I_{DSS}^*	Minimum and maximum drain current † $V_{DS} = 20\text{ V}$ $V_{GS} = 0$			
	2N4391	50	150	mA
	2N4392	25	75	mA
	2N4393	5	30	mA
V_{DSSat} ($V_{DS(ON)}$)	Maximum drain-source saturation voltage † $V_{GS} = 0$ $I_D = 12\text{ mA}$ 2N4391 $V_{GS} = 0$ $I_D = 6\text{ mA}$ 2N4392 $V_{GS} = 0$ $I_D = 3\text{ mA}$ 2N4393		0.4 0.4 0.4	V V V
C_{11SS}	Maximum small signal common-source input capacitance † $V_{DS} = 20\text{ V}$ $V_{GS} = 0$ $f = 1\text{ MHz}$ All types		14	pF
C_{22SS}	Maximum small signal common-source output capacitance † $V_{DS} = 20\text{ V}$ $-V_{GS} = 12\text{ V}$ $f = 1\text{ MHz}$ All types		5	pF
C_{12SS}	Maximum small signal common-source reverse transfer capacitance † $V_{DS} = 0$ $-V_{GS} = 12\text{ V}$ $f = 1\text{ MHz}$ 2N4391 $V_{DS} = 0$ $-V_{GS} = 7\text{ V}$ $f = 1\text{ MHz}$ 2N4392 $V_{DS} = 0$ $-V_{GS} = 5\text{ V}$ $f = 1\text{ MHz}$ 2N4393		3.5 3.5 3.5	pF pF pF

* Pulse test required, pulse width = 300 μs , duty cycle = 3 %

5 CHARACTERISTICS

 $T_{amb} = 25^{\circ}\text{C}$ unless otherwise stated.

† = Characteristics verified under inspection requirements.

PARAMETER AND TEST CONDITIONS				Min.	Max.	Unit
$t_{d(on)}$	Turn-on delay time **†					
	$V_{DD} = 10\text{ V}$ $V_{GS(ON)} = 0$ $C_L = 0$					
	$-V_{GSoff} = 12\text{ V}$	$R_L = 800\ \Omega$	2N4391		15	ns
	$-V_{GSoff} = 7\text{ V}$	$R_L = 1.6\text{ K}\Omega$	2N4392		15	ns
	$-V_{GSoff} = 5\text{ V}$	$R_L = 3.2\text{ K}\Omega$	2N4393		15	ns
$t_{d(off)}$	Turn-off delay time **†					
	$V_{DD} = 10\text{ V}$ $V_{GS(ON)} = 0$ $C_L = 0$					
	$-V_{GSoff} = 12\text{ V}$	$R_L = 800\ \Omega$	2N4391		20	ns
	$-V_{GSoff} = 7\text{ V}$	$R_L = 1.6\text{ K}\Omega$	2N4392		35	ns
	$-V_{GSoff} = 5\text{ V}$	$R_L = 3.2\text{ K}\Omega$	2N4393		50	ns
t_r	Rise time **†					
	$V_{DD} = 10\text{ V}$ $V_{GS(ON)} = 0$ $C_L = 0$					
	$-V_{GSoff} = 12\text{ V}$	$R_L = 800\ \Omega$	2N4391		5	ns
	$-V_{GSoff} = 7\text{ V}$	$R_L = 1.6\text{ K}\Omega$	2N4392		5	ns
	$-V_{GSoff} = 5\text{ V}$	$R_L = 3.2\text{ K}\Omega$	2N4393		5	ns
t_f	Fall time **†					
	$V_{DD} = 10\text{ V}$ $V_{GS(ON)} = 0$ $C_L = 0$					
	$-V_{GSoff} = 12\text{ V}$	$R_L = 800\ \Omega$	2N4391		15	ns
	$-V_{GSoff} = 7\text{ V}$	$R_L = 1.6\text{ K}\Omega$	2N4392		20	ns
	$-V_{GSoff} = 5\text{ V}$	$R_L = 3.2\text{ K}\Omega$	2N4393		30	ns
$r_{DS(ON)}$	Maximum drain-source on-state resistance †					
	$I_D = 1\text{ mA}$ $V_{GS} = 0$					
			2N4391		30	Ω
			2N4392		60	Ω
			2N4393		100	Ω
	$-I_D = 1\text{ mA}$ $V_{GS} = 0$					
			2N4391		30	Ω
			2N4392		60	Ω
			2N4393		100	Ω

** For pulse waveforms see Appendix 2.

6 MARKING

- 1) Each transistor shall bear the following marking:
 - a) The manufacturer's type number (see Table 1).
 - b) The factory identification code.
 - c) The date code.
- 2) Each package containing one or more of these transistors shall bear all the above markings except (b) and in addition
 - d) The detail specification number (see Table 1).

- 3) Interpretation of marking information

	XXXXXX	X	-Y
Device Type No.			
Quality Assessment Level			
Screening Sequence			

KEY:

Quality Assessment Level
(CECC 50,000 ISSUE III APPENDIX IIA)

E
F
L

Screening Sequence (CECC 50,000 ISSUE III APPENDIX VI)	BLANK	No Screening
	A	Sequence A
	B	Sequence B
	C	Sequence C
	D	Sequence D

7 ORDERING INFORMATION

The following minimum information is necessary to order a specific device, unless otherwise specified:

- precise type number
- CECC reference of detail specification with issue number and/or date when relevant
- level of quality assessment as defined in Appendix II A of CECC 50 000, and, if required, screening sequence as defined in Appendix VI of CECC 50 000
- any other particulars

Orders for these transistors shall contain the following minimum information

TABLE 1

ORDER TYPE	SPECIFICATION NUMBER	MARKING
BS 2N4391X - Y to	BS CECC 50 012 - 004 Issue 2 dated Mar. 1982	2N4391X - Y
BS 2N4392X - Y to	BS CECC 50 012 - 004 Issue 2 dated Mar. 1982	2N4392X - Y
BS 2N4393X - Y to	BS CECC 50 012 - 004 Issue 2 dated Mar. 1982	2N4393X - Y

TEST CONDITIONS AND INSPECTION REQUIREMENTS

GROUP A LOT-BY-LOT

ND - NON-DESTRUCTIVE TESTS

AQL - given in %

EXAMINATION OR TEST	D or ND	REF. BS CECC 50 000	CONDITIONS $T_{amb} = 25^{\circ}\text{C}$ unless otherwise stated	INSPECTION REQUIREMENTS								
				LIMITS			LEVELS					
				Min.	Max.	Unit	E		F		L	
							IL	AQL	IL	AQL	IL	AQL
SUBGROUP A1												
Visual inspection	ND	4.2.1					I	0.65	I	0.65	I	0.65
SUBGROUP A2a												
Leakage current with drain short-circuited to source $-I_{GSS}(1)$	ND	4.3.4 T.071	$-V_{GS} = 20\text{ V}$ $V_{DS} = 0$ All types		1.0	nA	II	0.15	II	0.15	II	0.15
Gate-source cut-off voltage $-V_{GSoff}$	ND	4.3.4 T.074	$V_{DS} = 20\text{ V}$ $I_D = 1\text{ nA}$ 2N4391 2N4392 2N4393	0.4 0.2 0.05	20.0 15.0 9.0	V V V						
SUBGROUP A2b												
Leakage current with drain short-circuited to source $-I_{GSS}(1)$	ND	4.3.4 T.071	$-V_{GS} = 20\text{ V}$ $V_{DS} = 0$ All types		100	pA	II	0.4	II	1.0	II	1.0
Gate-source cut-off voltage $-V_{GSoff}$	ND	4.3.4 T.074	$V_{DS} = 20\text{ V}$ $I_D = 1\text{ nA}$ 2N4391 2N4392 2N4393	4.0 2.0 0.5	10.0 5.0 3.0							
Drain current I_{SS}^*	ND	4.3.4 T.072	$V_{DS} = 20\text{ V}$ $V_{GS} = 0$ 2N4391 2N4392 2N4393	50 25 5	150 75 30	mA mA mA						
Drain cut-off current $I_{DSX}(1)$	ND	4.3.4 T.073	$V_{DS} = 20\text{ V}$ $-V_{GS} = 12\text{ V}$ 2N4391 $V_{DS} = 20\text{ V}$ $-V_{GS} = 7\text{ V}$ 2N4392 $V_{DS} = 20\text{ V}$ $-V_{GS} = 5\text{ V}$ 2N4393		100 100 100	pA pA pA						
Drain-source saturation voltage V_{DSsat} ($V_{DS(ON)}$)	ND	4.3.4 T.085 IEC 147-2G Clause 15	$V_{GS} = 0$ $I_D = 12\text{ mA}$ 2N4391 $V_{GS} = 0$ $I_D = 6\text{ mA}$ 2N4392 $V_{GS} = 0$ $I_D = 3\text{ mA}$ 2N4393		0.4 0.4 0.4	V V V						
Drain-source on-state resistance $r_{DS(ON)}$	ND	4.3.4 T.082	$V_{GS} = 0$ $I_D = 1\text{ mA}$ 2N4391 2N4392 2N4393 $V_{GS} = 0$ $-I_D = 1\text{ mA}$ 2N4391 2N4392 2N4393		30 60 100 30 60 100	Ω Ω Ω Ω Ω Ω						

* Pulse test required, pulse width = 300 μs , duty cycle = 3%