

APPLICATION NOTE

GaN HEMT Biasing Circuit with Temperature Compensation

The circuit shown in Figure 1 provides gate and drain voltages to Cree GaN HEMT transistors in the correct sequence to allow operation of these depletion mode RF devices i.e. negative gate voltage is generated and supplied to the GaN device prior to drain voltage being applied. The bias sequencing

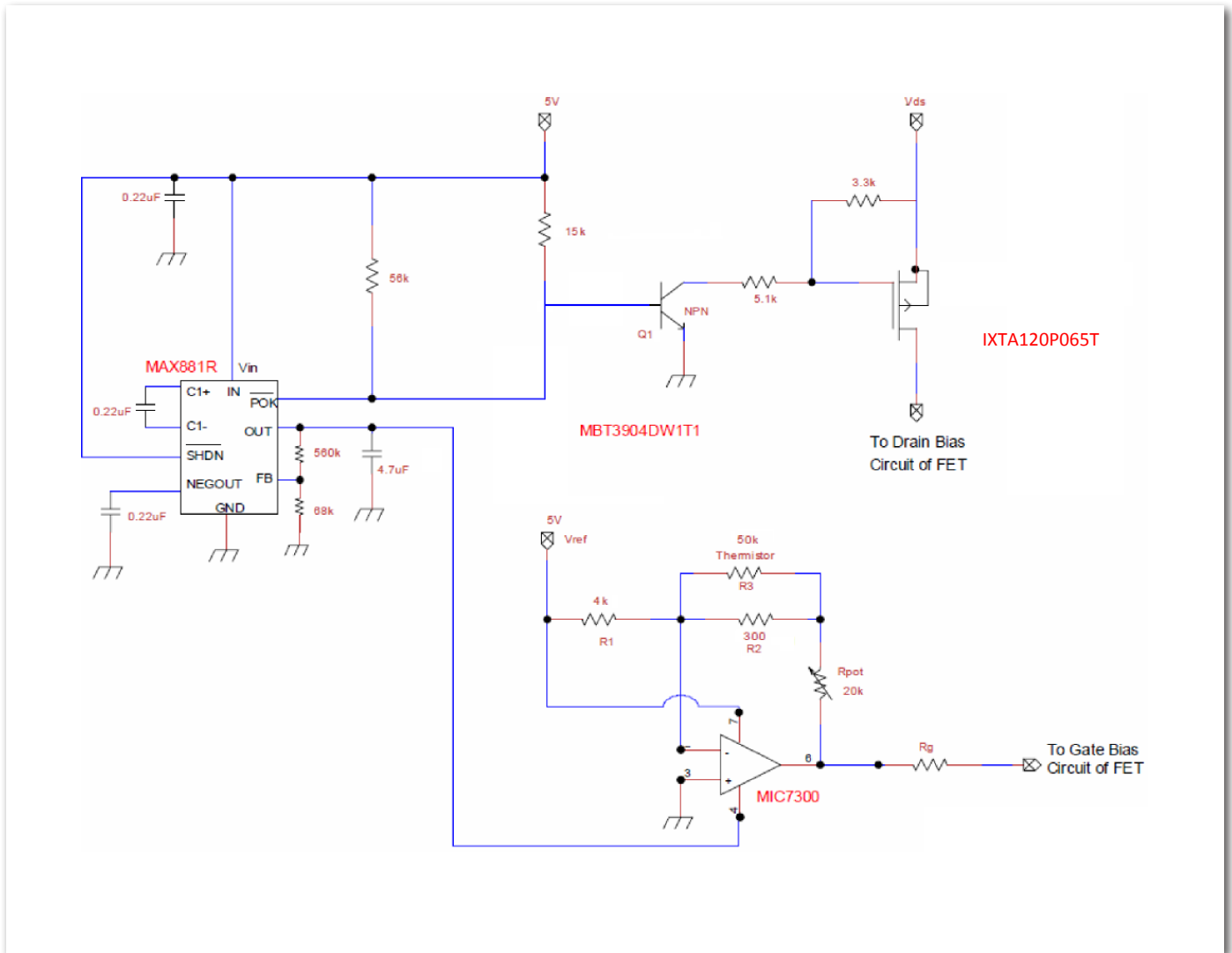


Figure 1.

is provided by a Maxim MAX881R IC which is operated from a +5 volt supply only. In addition to bias sequencing the circuit also provides temperature compensation to the RF transistor by changing the gate voltage to assure constant drain current. The Maxim MAX881R IC incorporates a charge pump which supplies a negative voltage to the Micrel MIC7300 operational amplifier. In addition the MAX881R provides a signal that turns on the IXYS IXTA120P065T MOSFET switch following the stabilization of the generated negative supply. The charge pump is capable of supplying the negative gate current required for the circuit



CONTINUED FROM PAGE 1

and the operational amplifier is capable of supplying the required positive or negative gate current to the GaN HEMT depending on the degree of RF compression in the device.

The IXYS MOSFET switch was chosen to assure that it is capable of supplying the maximum likely drain currents for a range of Cree GaN HEMTs as well as providing minimum voltage drop from the V_{DS} rail to the RF transistor drain. The IXTA120P065T MOSFET has an $R_{DS(ON)}$ of 10 milliohms and a $V_{D(MAX)}$ of 120 volts. So, for example, for the CGH40120F transistor (capable of producing 120 watts CW RF power) the average drain current is typically 7 amps and, therefore, the maximum voltage drop across the MOSFET (which is given by to $R_{DS(ON)} * I_{AVE}$) is equal to 0.07 volts with a dissipated power of 0.49 watts.

Typically the gate voltage for a Cree GaN HEMT needs to be changed by 0.4 mV per degree Celcius to maintain a constant drain current. The circuit in Figure 1 incorporates a Panasonic ERT-J1VV473J thermistor to sense temperature (the thermistor should ideally be placed as close to the transistor as possible to measure its temperature accurately). This thermistor is placed in the feedback loop of the Micrel operational amplifier such that the feedback tracks the gate voltage required to maintain constant drain current. In addition the quiescent drain current at a reference temperature is set by RPOT. The exact temperature coefficient of the gate voltage is set by the values of R1 and R2 in unison with the thermistor.

TEMPERATURE COMPENSATED CIRCUIT BILL OF MATERIALS

Part Number	Description	Manufacturer
MAX881R	Bias Sequencer	Maxim
MIC7300	Operational Amplifier	Micrel
MBT3904DW1T1	Dual NPN	ON Semiconductor
IXTA120P065T	Power MOSFET	IXYS
ERT-J1VV473J	47k Ohm 5 %, 0603 Thermistor	Panasonic
3224-1-203E	20k Ohm Potentiometer	Bournes
Resistors	0603, 5 %, Thin Film	Various
Capacitors	0603, 10 %, Ceramic	Various